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HYDROVAC

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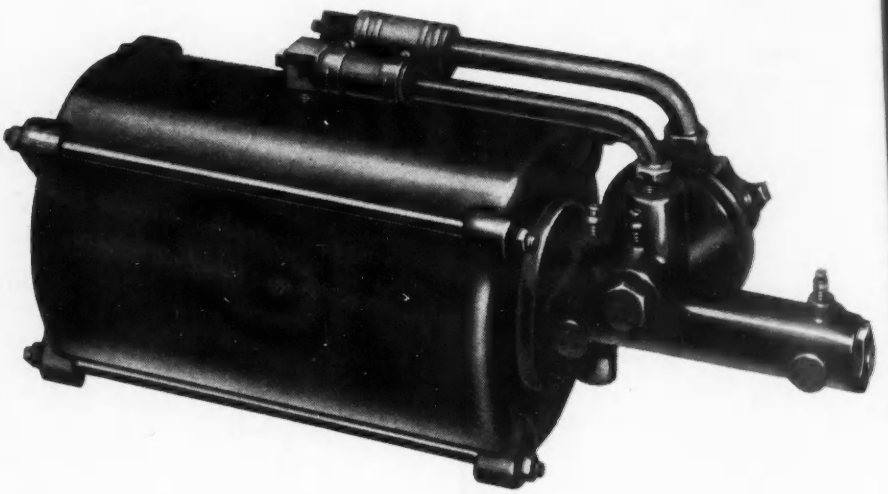

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THE WHITE HOUSE
WASHINGTON

December 1, 1945

Dear Mr. Crawford:

It gives me pleasure on the occasion of your first postwar annual meeting to express deep appreciation for the extensive and practical contributions to victory in World War II made by the technical committees of the Society of Automotive Engineers.

The results achieved through their efforts in response to requests from our Army, our Navy, and numerous civilian branches of the government are striking examples of the superior effectiveness of free technicians working voluntarily and aggressively in the service of their nation.

To the SAE for having provided the means through which such cooperation could be implemented and to each of the individuals whose talents and willingness made that cooperation possible, I give my warm thanks.

Very sincerely yours,

Harry Truman

Mr. James M. Crawford,
President,
Society of Automotive Engineers, Inc.,
29 West 39th Street,
New York 18, N. Y.

1946 ANNUAL MEETING TURNS TO PRACTICAL SERVICE OF I

Highlight of the first peacetime SAE Annual Meeting banquet since World War II was the address by HENRY FORD II (above) in Detroit's Masonic Temple – jammed with an audience of more than 2500 for the occasion

Capacity attendance was recorded at most of the 25 technical sessions of the five-day meeting, at which 45 technical papers were presented by more than 50 authors in the Book-Cadillac Hotel

A new feature provided by the National Meetings Committee was the Tuesday Buffet Luncheon, where more than 750 SAE members had the first opportunity in years to meet many friends. (See pp. 22 and 23.)

Total attendence at the 1946 Annual Meeting reached an all-time record of more than 5000 SAE members and guests

Most of these papers are available from the Special Publications Department, SAE Headquarters. (See Checklist, pp. 37 to 39.)

THE OPPORTUNITY which a peacetime future offers to the great group of industries whose roots go back to the internal-combustion engine, inspired the ramified technical discussions at the Society's 1946 Annual Meeting.

While this vision of still greater contributions to human well-being was the spark, there was nothing visionary in the meeting's approach to the technical problems which lie ahead. Rather the approach was as down-to-earth as would be expected of engineers – as practical as President-Elect Buckendale's observation at the Annual Dinner that "You can't ride or live in a picture in a magazine."

War-won knowledge was put to work. New horizons were opened up. From the broad problems of how to make better vehicles and aircraft to the more specific ones of improved transmissions and suspensions, jets and turbines, better utilization of fuels and lubricants, and freeing the air transport from the shackles of bad weather, the automotive engineering potential was surveyed in many of its major aspects. And a look was taken over our present horizons at the currently remote possibilities of atomic energy.

Viewed from any angle, the meeting was the greatest in the Society's history. Statistically more engineers attended more technical sessions to hear more papers than ever before. At one technical session after another the "Standing Room Only" sign had to be hung out because of the absorbing interest of the proceedings. Members came from far and wide in unprecedented numbers despite the discomforts of transportation and the shortage of hotel rooms.

Interest at the meeting reached a climax at the Annual Dinner. Henry Ford II, who made the principal address, packed them in. More than 2000 wedged their way into the huge dining hall in Detroit's mammoth Masonic Temple to hear the youthful president of the Ford Motor Co. put human engineering in the forefront of the problems which must be solved if this country is to realize its economic potentialities. "If we can solve these problems," he forecast, "we can make as much progress toward lower costs during the next 10 years as we made during the past quarter century through the development of the machinery of mass production."

The dinner audience also was thrilled by a letter from the President of the United States expressing appreciation for the contribution the Society's technical committees made to Victory. In his letter, which President Crawford read, Mr. Truman said of the work of SAE Committees: "The results achieved through their efforts in response to requests from our Army, our Navy, and numerous civilian branches of the Government, are striking examples of the

New SAE President Assumes His Tasks

Past-President James M. Crawford congratulating President L. Ray Buckendale, right, upon his election by Members as the Society's 1946 leader

TIN TURNS WAR-ENGINEERING
VIC OF INDUSTRY IN PEACE!

superior effectiveness of free technicians working voluntarily and aggressively in the service of the nation."

While predominant technical emphasis at the meeting was on the engineering problems of a peaceful future, there was an awareness in the meeting atmosphere that in the still-troubled political world, military problems must not be allowed to fade into the engineering subconscious as they have after other wars. This awareness found forceful expression in the dinner remarks of incoming SAE President, L. Ray Buckendale. He stressed the important contribution SAE technical committee work will make to peacetime progress, but warned that "We must also not forget to keep our weapons sharp. We must keep our country out in front technically and productively. We must develop and keep developed a nucleus of the latest weapons of war because he who is alert and has sharp weapons is rarely attacked."

What cars, trucks, and buses will be like when the results of wartime progress and postwar development work get into production, evoked spirited discussion involving both engineering and imagineering. Passenger cars with engines in the rear and with bodies produced by airplane design and structural practices were debated. Buses with most of the comforts of home were pictured as were trucks with greatly improved characteristics. In addition some of the perennial problems which have been featured at many SAE meetings came in for further airing. Among these might be mentioned what to do about transmissions, improved riding and handling, and better utilization of fuels in all types of internal-combustion engines.

The wraps of military secrecy were taken off jet engine developments for the first time. As a result, the rank and file of SAE members had their first chance for a close-up of radically new powerplants. Through the courtesy of the Army Air Technical Command and the Navy Bureau of Aeronautics there was a representative display of jet jobs which have been developed both here and abroad. Technical sessions at which the intricacies of their design were examined stimulated interest in these displays.

Banquet Toastmaster

SAE Past-President William J. Davidson, administrative officer, General Motors Technical Center, who served as the Annual Meeting Banquet Toastmaster

Record Annual Dinner

THE best industrial statesmanship of which we are capable was urged as necessary to the solution of pressing problems of human relations by Henry Ford II, president of the Ford Motor Co., in his address on "The Challenge of Human Engineering," which was heard by the largest SAE Annual Dinner audience in history.

Mr. Ford was introduced by Past-President W. J.

Record Registration . . .

More than 5000 SAE Members and guests participated in the 1946 SAE Annual Meeting, Book-Cadillac Hotel, Detroit, Jan. 7 to 11. Registration for the 25 technical sessions broke all previous records in the history of the Society

Davidson, whose toastmastering of the event was well up to the standard which SAE members have come to expect of him. Other features of the program were addresses by President J. M. Crawford and by President-Elect L. Ray Buckendale.

After sketching some of the aspects of the human relations problem, Mr. Ford continued:

"We continually talk about higher incomes, and higher wages, and more money. That is all right. A man should be ambitious, he should try to increase his income. But in our discussion of higher incomes, we must never lose sight of the universal advantages of lower costs – of more and better products brought within the budget of more and more people.

"In the face of what peacetime mass production has already accomplished in raising our standard of living, in the face of current world praise of American industry's ability to produce great quantities of things in a short space of time, we may be tempted to think that the potentialities of mass production have been exhausted – that we have come to the end of this road to national well-being. Such a notion is absurd. The mechanics of mass production can still be greatly improved, and they can be more widely adapted.

"But there is a whole vast area in which we are only beginning to make significant progress – what we might call the field of human engineering. Machines alone do not give us mass production. Mass production is achieved by machines and men. And while we have gone a very long way toward perfecting our mechanical operations we have not successfully written into our equations whatever complex factor represents Man, the human element.

"I am suggesting, therefore, that we try to rewrite the equation to take into account the human factor. If we can solve the problem of human relations in industrial production, I believe we can make as much progress toward lower costs during the next 10 years as we made during the past quarter century through the development of the machinery of mass production.

"In approaching the complex problems of human relations, I believe that management must take the initiative for developing the relationships between labor and management. Labor has a great opportunity to achieve stature through assuming responsibility. But I consider that management is in charge, that management must manage, and that the test of management is whether or not it succeeds.

"Mass production did not invent the human equation – but it did alter it in a number of important respects which we may have been slow in taking into account. Under mass production large numbers of people flocked to the assembly line, each to perform a highly specialized routine duty. Mass production produced great concentrations of people – and a problem of communicating with them. And it produced the difficult problem of specialization, where the human loses sight of the social usefulness of what he does.

"How badly we have taken the human factor into account is indicated by many statistics. The Department of Labor shows that a total of 216,000,000 man-days were lost between 1927 and 1941 as a result of strikes alone . . . This idleness was expensive – to the strikers, to the companies, and to the nation."

*

"Costs are closely related to the productivity of the individual American worker. We take pride in this productivity, and as a matter of fact we in America cannot compete in world markets with our high wage rates if

the American worker does not continue to be productive.

"Recent statistics on productivity are confusing because of the factor of war. War necessarily brought into industry a great many less experienced men and women. The armed forces took away a great many skilled workers.

"Other prewar mass production industries have found, as have we at Ford Motor Co., that even after allowance for these unusual circumstances the recent record of productivity is not encouraging."

*

"As we look at these problems in human relations, we feel that the solution must be found through a closer understanding between management and labor. If we cannot succeed by cooperation, it doesn't seem likely that we can succeed by any exercise of force. We cannot, for example, expect legislation to solve our problems. Laws which seek to force large groups of Americans to do what they believe is unfair and against their best interests are not likely to succeed. In fact, such legislation can lead to exaggeration of the very problem it is designed to solve. And when free men give up the task of trying to get along with each other, and pass the buck to Government, they surrender a substantial measure of their freedom."

*

"There are many considerations which we must take into account as we work toward a solution of this problem. I can name some that had occurred to me and you will think of others.

"I assume, for example, that all of us agree that Labor Unions are here to stay . . . We do not want to destroy the Unions. We want to strengthen their leadership by urging and helping them to assume responsibilities they must assume if the public interest is to be served . . ."

*

"What is needed today is industrial statesmanship – from both labor and management . . . Only recently have we begun to develop and use modern techniques which enable us to fit people to jobs and fit jobs to people, with some degree of science . . . When we have learned to do a reasonably good job of evaluating an employee's capacities at the start of his career, we can do a better job of upgrading . . . Communication between management and employees in large mass production plants is another important field in which we can work . . . People want to know what the other people they work with are doing and thinking.

"The important thing, it seems to me, is to recognize the problem for the vital one it is and to move forward in hope and confidence and intelligent experimentation toward workable solutions.

"As a starting point for continuing efforts in that direction, perhaps Management and Labor would today agree:

1. That the job of American Industry – Management and Labor – is to make at lower and lower cost more and better products to sell for lower and lower prices.

2. That the only way that job can be done is through understanding and sensible cooperation between Management and Labor.

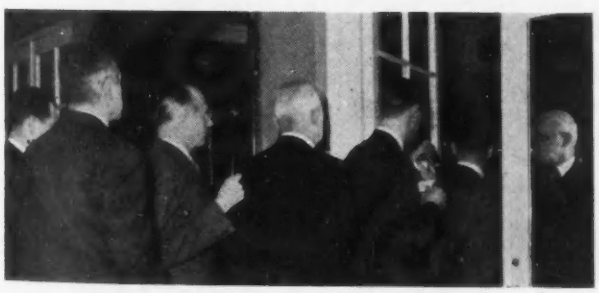
3. That the spirit of that cooperation must be a sense of joint responsibility. The Public is the "Boss," not Management or Labor. Both Labor and Management must accept their share of responsibility to the public welfare and live up to their commitments.

4. That mass production has demonstrated its ability to bring high wages, and that higher wages can come only out of greater production and lower costs.

5. That, while no single human institution or industry can promise complete security because of the complexity of modern civilization, Management and Labor can work toward more certain, more stabilized employment.

6. That American industry should be a place of oppor-

Standing Room Only



Overflow Attendance

Buffet Luncheon at Annual Meeting

More than 750 SAE Members attended the informal Buffet Luncheon at the 1946 Annual Meeting in Detroit. How many of your friends do YOU see?

Capt. W. C. Gerler, Air Technical Service Command, explained design and construction details of a captured German Jumo 004 jet engine at the Wednesday Aircraft Powerplant Session, and is shown here with the engine. Through the courtesy of the ATC and the Navy Bureau of Aeronautics, these American and German jet engines were also displayed at the SAE Annual Meeting: General Electric I-40, Westinghouse 19-B and 9½-A, German BMW 003A, and the Heinkel-Hirth He S8A

tunity – a place in which men and women can grow and develop into better jobs.

"If these are our articles of industrial faith, then we are squared away to attack the problem of making mass-production more efficient by giving the same hard-headed attention to human factors that we have given so successfully in the past to mechanical factors. The only approach we can take is to live up to the best industrial statesmanship of which we are capable. If we give the best we have, we can hope to get the best in return."

Crawford Praises SAE War Engineering

In his address, President Crawford expressed his appreciation for the support he had received from the membership during his term of office and the pleasure he had had in service of the Society. Following his presentation of the letter from the President of the United States thanking the Society for the contributions it had made to Victory through its technical committee work during the War, he introduced the members of the SAE War Activity Council who directed these operations, concluding with a moving tribute to B. B. Bachman, chairman of the Council, for his substantial contributions to the Society's progress. He concluded with an announcement that the Society had received a bequest from the late David Beecroft, president of the Society in 1921, amounting to $2500 and to provide for 10 annual awards of $250 each to be administered by the Past-Presidents' Advisory Committee.

President-Elect Buckendale, in his address, stressed the importance of continued cooperation in industry and between industry and the armed forces, on mutual technical problems. He said in part:

"There is one object for the Society, however, and that is to put the lessons learned during the war at work to help win the peace. The combined talents and experiences of our technical members were coordinated toward winning the war and the Society received much praise for that work.

"Our Society has in its membership men who are specialists in every field of the mechanical arts.

"In line with the lessons taught by the war, the whole technical committee structure of the Society has been revamped. Instead of a great many uncoordinated committees, we now have set up and are coordinating all technical, research, and standardization work of the Society under the new Technical Board – and the organization of committees under the Technical Board is progressing rapidly toward the end that all of our Society's technical talent can be directed toward problems which require coordinated effort, not only of specialists in one particular field but the efforts of men with varied talents and experiences . . .

"The challenge to me is to strive to make the Society even more in its technical field the power in the land that its membership and talent potential indicate that it should be, so that – although 1945 will be remembered as the year which won the war, 1946 will be the year which found the true road to sanity and productive peace."

Annual Business Meeting

Mac Short, president of the Society in 1943, was awarded a certificate of life membership at the Annual Business Meeting. Formal announcement also was made of the election of officers for 1946. In addition Messrs. J. M. Crawford, R. R. Teetor and R. L. Weider were elected members-at-large of the National Nominating Committee.

Horning Award to C. B. Veal

Horning Memorial Award for 1944 was presented by Mrs. Horning to C. B. Veal, Coordinating Research Council, Inc., in recognition of distinguished active service in the field of mutual adaptation of fuels and engines. W. M. Holaday presided as chairman.

Established in memory of Harry L. Horning, SAE presi-

dent in 1925, and one of the pioneers in the field of cooperative research work on fuels, the award was presented at this year's annual meeting for the first time since 1940.

Speaking on "Philosophy of Cooperative Research," Mr. Veal described the role of cooperative research as one of collective application of principle and utilization of design, rather than one of pioneering. Thus, a topic is ready for cooperative research only when a certain level of common knowledge concerning it has been reached. Tools, he said, are statistics, establishment of a common vocabulary and common methods of measuring the properties and performance of materials and equipment, and education, as a means of instructing less experienced men, aiding intercommunication among the more experienced, and building up a common body of knowledge.

Organization of the CFR and CRC, he reported, encompasses working groups of from five to fifteen, investigating specific topics; a supplementary technical organization whose function it is to perform for the groups the technical tasks they cannot do; and a central headquarters staff for purposes of administration.

Mr. Veal believes that an organization such as CRC, with its multiplicity of interests, has not only a unique opportunity to contribute to technical advance, but also "an inescapable responsibility for so doing."

Junior Student Session

The really forward looking thinkers whose crystal balls have been showing pint-sized engines using atomic energy in our cars and planes, were slowed down early in the meeting by Columbia's John R. Dunning who talked on the development of atomic energy at Monday evening's Student session, which Paul Huber chairmanned. Dr. Dunning's paper indicated that for quite some time in the future we will continue to buy fuel for our cars and planes by the gallon rather than by the atom. His estimate of the future was that "The radiation shielding of adjacent personnel from the enormous radiation of neutron and gamma rays is a serious problem because walls many feet thick are required at present. This seems to limit the immediate application to large units. Large planes may eventually be powered thus, but small planes and cars seem very remote at present . . . However, it seems very unlikely that atomic power will ever really replace our common fuels in most applications. The new fuel is likely to be a supplement to existing methods."

Development of Atomic Energy – DR. JOHN R. DUNNING, Pupin Physics Laboratories, Columbia University

WIDESPREAD popular interest in atomic bombs developed with disclosure of their effect on two Japanese cities, but scientific interest in the use of atomic energy, Dr. Dunning related, has existed for many years. In fact, the first atom smashing was accomplished in 1909 by the British physicist Rutherford. Since then physicists have been busy firing subatomic particles at atomic nuclei by using radioactive materials or particles speeded up to thousands of miles per second by high voltage generators and cyclotrons. We have been able to transmute atoms into new atoms – forming over 400 artificial radioactive isotopes, Dr. Dunning reported.

In the production of concentrated U-235 many engineering problems had to be solved. The author related that the vacuum tightness specifications of the plant had to be held to previously unheard-of limits. Over 20,000 miles of welding were employed and over 200,000 vacuum joints made.

In discussing the possibilities of atomic energy, Dr. Dunning stated that the immediate problem is how to utilize the intrinsic high temperatures (in excess of billions of degrees) effectively. Fortunately, he added, the energy can be "degraded" and used at lower temperatures.

The conventional type of heat engines, such as turbines and gas turbines, according to the author, can be utilized in principle. The heat transfer problems and the high temperature properties of available alloys set out present limits, though, the author added. Application to stationary powerplants and to large propulsion problems, such as ships, seems to him to be readily practical in time with adequate research and development.

Jet-momentum devices for large planes and rockets likewise appear promising to the author. Use of only partially concentrated U-235 combined with maximum utilization of U-238 and other materials seems to him to be most likely.

Dr. Dunning concluded, however, that it appears very improbable that atomic power will ever really replace our common fuels in most applications. The new fuel is likely rather to supplement existing ones. The immediate applications seem to him to be in the premium fuel field and where the special advantages of atomic power outweigh costs.

DISCUSSION

Replying to a question by H. M. Martin, General Electric Co., concerning the liberation of energy in the explosion of an atomic bomb, Dr. Dunning said that explosions

Mrs. Harry L. Horning, of Waukesha, Wis., presents the SAE 1944 Horning Memorial Award to C. B. Veal, secretary-manager of Coordinating Research Council. W. M. Holaday, of Socony-Vacuum Oil Co., Inc., was chairman of the Thursday evening meeting at which Medalist Veal delivered the Horning Memorial Lecture. On Dec. 20, 1945, Mr. Veal received the War Department's Certificate of appreciation "for patriotic services, in a position of trust and responsibility, for outstanding services rendered in time of war through the research and materials program of the Ordnance Department." The certificate was signed by Secretary of War Robert Patterson

can occur only so long as the size of the explosive material is above the critical mass. Once the size decreases below that amount, the reaction stops. He explained that at the center of the explosion the temperature is extremely high, so that the surrounding gases are also heated to a high degree. Radiations of light, X-rays, and gamma-rays are given off, followed by a shock wave. In fact, except for the center of the explosion, he stated that it is similar to an ordinary explosion.

The massive cloud that is visible in pictures taken of atomic bomb explosions, Dr. Dunning pointed out, is actually formed long after the initial shock wave. The high-temperature disturbance stirs up dust that, along with disintegrated atoms and nitrous oxide, is swept high up into the sky in a chimney-shaped column.

Another member of the audience was worried about bombs being made so large that the whole world might explode. Dr. Dunning explained that there is no reason for thinking in terms of such an event. Physicists can calculate the total energy released within a couple of a per cent. These calculations are carefully made and then checked many times, so that there can be no possibility of something unforeseen happening.

Use of thorium was suggested by a discusser. Although thorium is more abundant in nature than uranium, Dr. Dunning replied, for various reasons it is not as satisfactory. Nuclear fission is an extremely rare phenomenon and just any element cannot be used.

PASSENGER CAR SESSIONS

Chairmen

H. T. Youngren ★ **G. A. Delaney** ★

Suspensions and automatic transmissions were analyzed from almost every possible angle at two stirring passenger-car sessions. Both topics were treated on a symposium basis and, in both instances, emphasis was laid on the interrelationships of each of the individual engineering problems which go to make up the design as a whole.

Fundamentals of Suspension **– H. E. CHURCHILL, P. G. HYKES and M. Z. DELP, The Studebaker Corp.**

(*Presented by Mr. Churchill*)

A MAJOR rearrangement or redesign of the heavier components of the passenger car probably is not far away, the authors believe, because recent trends in suspension – as continued – will bring about further unbalance of front and rear weights and, consequently, increase the problems of braking, steering, and behavior over rolling roads or in turns.

The trends discussed by the authors as bringing about improvements in ride, but also some increased problems, included trends toward a lower center of gravity, decreased spring rates, and decreased tire rates; the shift in passenger location nearer to the center of gravity and the decrease in oscillatory frequency.

Psychological as well as physical aspects of riding comfort were emphasized, the authors stressing that the mental attitude of the car rider has much to do with both his comfort and his safety. "If any one of the major requirements of the complete automobile is deficient," they said, "occupants will feel ill at ease. . . . The powerplant, the body, the suspension system, the steering, power transmission and braking equipment must all blend into a harmonious whole. In addition there must be adequate ventilation, heating, and observation. Vibrations, whether they are carried up from the road through the suspension system or originate in the engine or power transmission system, must be kept to an absolute minimum. Engine noise, road noise, and wind noise must be largely eliminated to permit the driver to concentrate on his job. . . . He must not only be safe, he must feel safe."

Arguing that too few experimental data are available to refute or verify the various theories advanced concerning the motion of the automobile, the authors analyzed in detail the effects of the mass-elastic system on space and motion as they influence passenger comfort and of mass distribution with reference to the front and rear wheels as related to the safety of the vehicle.

DISCUSSION

Vibrations and oscillation centers depend on five factors, according to P. H. Pretz, Chrysler Corp. These are:

1. Wheelbase. This factor is of small importance since wheelbases of 90% of cars now built do not vary more than 1 in.

2. Mass. Discussion is not necessary since variation from cheapest to most expensive car is less than 1000 lb in 90% of the cases.

3. Fore-and-aft location of center of gravity. Recent trend has been a shift of c.g. toward the front axle, increasing problems of braking, steering, handling, traction, and tire wear. A continuation of this trend, in Mr. Pretz's opinion, will require omitting brakes from rear wheels, putting oversize tires on the front, and storing cars in slippery weather. He suggests as a superior solution a major redesign or rearrangement of the heavier components.

4. K^2/AB ratio. This represents the ratio of the radius of gyration squared of the sprung mass to the product of the division of the wheelbase length, as determined by the location of the center of gravity. The ratio has increased during the past 15 years, he said, from 0.5-0.7 to 0.8-1.0; it probably will not exceed unity, since further gains in comfort would be offset by increased difficulty in handling and decreased safety.

5. Spring deflection. This represents load divided by spring rate, and has great influence on basic frequencies and oscillation centers. The recent trend, Mr. Pretz pointed out, has been to increase spring deflections to the extent that today's better riding cars have oscillatory frequencies in the neighborhood of 60- to 80-cpm, as compared to 70 to 100, 10 years ago. Forty, he said, marks the low point since it borders on the seasickness range. He believes that even the heavier cars will not have spring deflections increased

turn to page 45

A few of the 2500 Members and guests who heard Henry Ford II, speak at the Annual Meeting Dinner in Detroit's Masonic Temple

SAE GERMAN ENGINEERING *Evaluation* MEETING

(A National Meeting sponsored by the Passenger Car and Truck and Bus Activities, with the cooperation of the Detroit Section)

Detroit — March 4

Horace H. Rackham Educational Memorial

The speakers at this meeting have been to Germany as part of various Army, Navy and Government missions to study first-hand details of Germany's wartime engineering results. The snapshots shown here are typical of hundreds of on-the-spot pictures taken by members of the various missions . . .

9:30 A.M.

INTRODUCTION

Technical Investigations of German Automotive Materiel
– Lt. Col. C. H. Corey, Ordnance Dept.

POWERPLANTS

German Army Vehicle Engines
– Maurice A. Thorne, General Motors Corp.

German Radiators and Oil Cooler Structures and Facilities for Manufacture
– Fred M. Young, Young Radiator Co.

BUFFET LUNCH—12 O'CLOCK
BANQUET ROOM

2:00 P.M.

POWER TRAINS

German Automotive Transmission Systems – Development and Design
– R. R. Burkhalter, Spicer Mfg. Corp.

The Highlights of German Transmission Design and Development
– Lt. Col. Ewen McEwen, Fighting Vehicle Design Dept., British Ministry of Supply

RUNNING GEAR & CHASSIS

Suspension and Track of German Military Track-Laying Vehicles
– Tore Franzen, Chrysler Corp.

Observations of Various German Suspensions and Steering Gear
– R. L. Weider, White Motor Co.

Observations on the German Rubber Industry
– Earl W. Glen, Goodyear Tire and Rubber Co., at present assistant director, Rubber Division, Civilian Production Administration

8:00 P.M.

FUELS AND LUBRICANTS

German Military Fuels and Lubricants
– Major N. L. Klein, Ordnance Dept.

HIGHWAYS

War Developments of the Oil Industry in Austria and Roumania
– Major L. J. Grunder, Technical Division, Army-Navy Petroleum Board

German Autobahn – Relation to German Industrial Economy and Traffic System Used
– John W. Wheeler, Burlington Lines

6:30 P. M. Dinner Banquet Room
Coffee Talk

American Design Engineers Move to the Front.

COL. J. M. COLBY, ***Ordnance Dept.***

SPECIAL EXHIBIT OF GERMAN AUTOMOTIVE MATERIEL – Courtesy of Major General G. M. Barnes, Chief Research and Development Service, Ordnance Dept.

Vistas Wide, Complex for Jet Propulsion Use

Digest of talk

by C. W. TERRY
Cornell University

■ Syracuse, Dec. 12

(Summary of ideas expressed by Prof. Terry in his talk on "Jet-Propeller Combinations versus Conventional Propulsion Systems for Airplanes")

THE primary purpose in using jet propulsion engines in airplanes has been to obtain better performance.

These engines are somewhat lighter (for a given maximum thrust horsepower) than the conventional reciprocating engine. The parasite drag of the jet propulsion powerplant installation is somewhat less than that of the conventional powerplant. Thus, the maximum speed of a plane powered with jet propulsion engines will be greater than with the conventional engine. However, maximum speed is only one of a number of performance items that should be considered. Others are rate of climb; ceiling; maneuverability; vulnerability to enemy fire; safety in case of crash landing; range, and endurance. These are by no means all of the items to be considered, but they will form a basis for comparison.

Rate of climb and acceleration depend on the amount of power available in excess of that required for level flight. The conventional engine-propeller combination (using a controllable pitch propeller) gives high thrust horsepower over a wide speed range. Thrust horsepower output of the jet propulsion engine, on the other hand, varies almost directly with speed, since the maximum thrust is nearly constant. For this reason, acceleration and rate of climb are not as good. For a fighter airplane, this is an item of primary consideration.

The Ryan Fireball, with its combination of conventional engine and jet propulsion engine, has good take-off and climb characteristics, the rate of climb at slow airspeed being somewhat less than for a comparable airplane with conventional engine only. The rate of climb at high airspeed is better, due to the rapid increase in jet propulsion engine power with increase in airspeed.

Ceiling of planes with either conventional engines or jet propulsion powerplants may be quite comparable. With turbosuperchargers on the former, and with the same inherent characteristics of the turbosupercharger incorporated in the jet propulsion engine, power may be maintained to very high altitudes with either. On account of the lighter weight of its powerplant, the jet propulsion engined plane probably has some advantage, but the time required to get to the high altitude may be greater due to the lower rate of climb. The question of maneuverability involves two factors – lower weight per horsepower, which favors the jet propulsion plane, and acceleration and rate of climb which favors the conventional engine and propeller. As a result it may be

turn to p. 31

Accumulator Performance Upped

Digest of paper

by K. C. MONROE
Vickers, Inc.

■ So. California, Nov. 11

(Paper entitled "Research and Development of Aircraft Accumulators")

ELEMENT of aircraft design made particularly difficult by the problem of weight is that of the accumulator. Extensive research and experimentation, Mr. Monroe pointed out, have gone into the development of what seems a simple device, but in reality is fraught with complications. A standard industrial installation accumulator, adapted to meet the rather specialized requirements of aircraft, he estimated, would weigh over six tons.

Serving about the same purpose in a hydraulic circuit as a storage battery in an electric circuit, the accumulator provides storage of fluid under pressure as potential energy for momentary delivery to the system, as a supplement to delivery from the pump.

Early aircraft hydraulic systems, Mr. Monroe explained, had relatively small volumetric and pressure requirements, and therefore no need for accumulators. However, gradually increased requirements made an aircraft version of the industrial application accumulator requisite . . . bomber and fighter requirements magnified the need, upped the importance of the accumulator by their intermittent volumetric requirements.

Satisfactory solution of the problem involved a gradual bettering of accumulator design, starting with the simple addition of an accumulator to the hydraulic circuit.

Purpose of the accumulator is to provide momentary delivery of hydraulic fluid in excess of pump capacity, and to absorb pulsations in the hydraulic system.

Developments Detailed

Subsequent step-by-step improvements described by Mr. Monroe include:

1. The addition of a check valve (Fig. 1) enables the accumulator to maintain pressure on the hydraulic system when the pump has stopped operating.

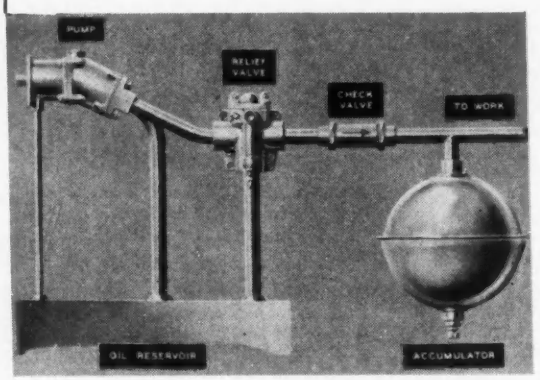
2. With an unloading valve (Fig. 2) acting as a pressure regulator, pump delivery continues, but by-passes the accumulator when it is fully charged, and returns to reservoir.

3. The hydropneumatic accumulator (Fig. 3) employs expanding gas to displace hydraulic fluid; although favorable for aircraft applications, it necessitates separation of air and oil, since oils used in aircraft hydraulic circuits have an affinity for air.

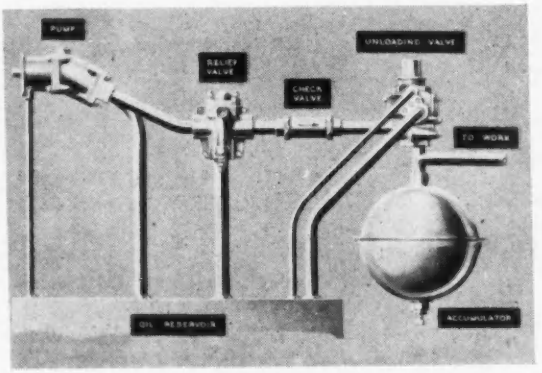
4. Floating piston, used to some extent as a separating agent in cylindrical accumulators, has disadvantages of excess weight and size, friction of seals on pistons, and possibility of leakage between air and fluid chambers from the wear of the seals.

5. Bag type of accumulator contains a bag which expands as fluid is discharged from the accumulator, contracts as accumulator is charged with fluid.

6. For maximum strength and minimum weight, Mr. Monroe believes, the spherical accumulator (Fig. 4) offers the best arrange-



■ Fig. 1 – Check valve added to hydraulic system to enable maintenance of pressure by accumulator when pump ceases to operate



■ Fig. 2 – Unloading valve added as pressure regulator to route pump delivery past fully-charged accumulator

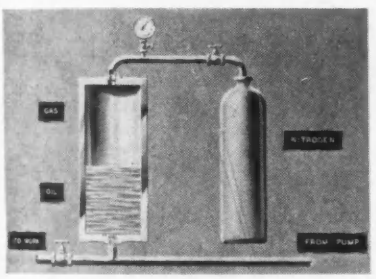
y Research

ment for aircraft use. It has additional qualities of minimum overall dimensions, maximum displacement, and maximum life in all types of aircraft service. A pliable synthetic diaphragm prevents external leakage and mixture of air and oil, and is flexible within the range of –65F to 160F.

Joint construction shown in Fig. 5, he said, has been found the most successful method of joining the two parts of the accumulator so that a diaphragm may be used. Uniform distribution of stresses, which contributes to maximum fatigue life, results from the smoothness of the completed assembly.

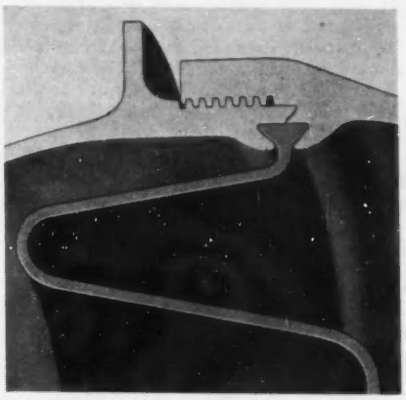
Hot, cold, heavy duty and normal duty cycle tests, and tests for stretch, burst, aging and other characteristics, Mr. Monroe said, have shown that the results of research and experiments . . . the accumulators now in service, have a life expectancy as long as that of any other aircraft hydraulic accessory.

Standard accumulators of 5, 7½, and 10 in. in diameter (Fig. 6) cover the requirements of almost every aircraft hydraulic system. A combination of sizes may be used, he explained, for any required volumetric capacity. However, a 10 in. accumulator, for instance, is equivalent to eight five in. accumulators; since the 10 in. model weighs only half as much as the combination, use of a larger accumulator is preferable from the weight standpoint.

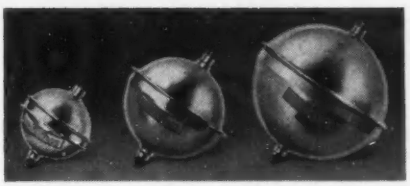


■ Fig. 3 (above) – Hydropneumatic accumulator

■ Fig. 4 (below) – Spherical accumulator



■ Fig. 5 – Joint construction of spherical accumulator



■ Fig. 6 – Three standard sizes of 1500 psi spherical accumulators

Efficient Maintenance Cuts Cost and Danger

Digest of paper

by F. C. LYNCH

U. S. Army, Ordnance Department

■ So. California, Oct. 26

(Paper entitled "Relations of Safe Maintenance")

THE value of every maintenance man to his company is measured in cost per vehicle mile, Col. Lynch pointed out. Reporting that an abnormal percentage of most maintenance charges derive from road accidents, he emphasized the value and the necessity of thorough preventive maintenance.

The fact that drivers tend naturally to shift the blame for accidents to parts failures (favoritely, air pipes), he said, adds greatly to the burden of responsibility borne by the maintenance department.

Statistics show failures of brakes, steering mechanism and tires to be the largest contributors to accidents which can be ascribed to lack of proper maintenance. In this connection, Col. Lynch condemned the widespread practice of testing brakes on empty vehicles. Braking effort may be sufficient to stop an empty truck safely, he warned, yet be completely incompetent under full load conditions.

Some manpower failures which cause accidents are partially the responsibility of the maintenance department, he said.

Fatigue may be traceable in some degree to improper maintenance of miscellaneous parts, which makes the driver's job more difficult.

Distraction caused by any mechanical failure may contribute to accident.

A driver annoyed because his truck refuses to respond well will be more susceptible to unnecessary accidents.

The safety record of a fleet, as Col. Lynch sees it, is so closely tied up with the quality of work produced by its maintenance department, that the latter owes it not only to safety, but also to its own budget, to turn out topnotch preventive maintenance work.

Better Diesel Starting Seen

Digest of paper

by ERWIN J. H. BENTZ

Caterpillar Tractor Co.

■ Peoria, June 11

(Paper entitled "Diesel Cold-Starting Problems")

RECENT developments preview an end to diesel cold starting problems, Mr. Bentz reported. Easier starting than that experienced in gasoline engines, at zero or subzero temperatures, may be expected.

The compression temperature on which diesel engine ignition depends, he said, decreases at almost twice the drop in ambient air temperature. With the addition of heat loss and other factors, low temperature conditions become even less favorable.

At the same time, diesel application has become broader in the automotive field, so that the temperature range within which engines must be able to start has constantly widened, and the number of necessary starts has increased. With the use of diesels by the armed forces in all parts of the world, need has arisen for vigorous attack on the starting problem.

In general, Mr. Bentz pointed out, starting becomes a problem with commercial diesel fuels and engines at 25 F.

Two approaches to the problem of reducing this minimum temperature limit are the application of heat to the engine to raise the compression temperature, and the use of special fuels and dopes to obtain lower ignition temperatures.

Heat, he said, may be applied to intake air, to jacket coolant, to entire engine, or directly in the combustion chamber. Application to intake air is most rapid and economical – that is, less heat units are required to get the engine to the point where it will pick up the cycle. A small flame in the intake manifold, using diesel fuel and part or all of the intake air, serves this purpose.

From 5 F to 30 F, he said, a small flame is sufficient to start the diesel, with enough oxygen left in the inlet air for the diesel to fire and pick up its cycle. At lower temperatures, all oxygen will be used up to produce sufficient heat to quickly raise the engine's combustion space temperature . . . then flame size can be reduced to the point where the engine can pick up the cycle. However, neither this method nor the use of electric heating elements in the inlet manifold has been found particularly suc-

cessful for diesels employing electric starting systems over a wide range of cold starting temperatures.

Cold starting and low temperature lubrication problems both are eliminated, he said, by maintaining the entire engine temperature above difficult starting temperatures. Jacket coolant heaters may be used, or heaters placed under an enclosure housing the engine or the vehicle.

Limits of commercial diesel fuels for cold starting diesels are roughly marked by cetane value. Highest cetane value fuel available, Mr. Bentz reported, seldom gives starts below 20 F for a starting time of 50 sec. His conclusion regarding the use of dopes to improve cold starting, based on numerous data, is that most materials used have little beneficial effect, but several varieties of harmful action . . . corrosion, instability, and so on.

Diethyl-ether and diesel fuel in about 50/50 blend, he said, has been shown to permit good starting down to —3 F ambient air temperature. Even more effective is direct addition of ethyl ether to the intake manifold during cranking. Quick starting at —40 F is possible, with low cranking speeds.

Wider and wider diesel applications, Mr. Bentz pointed out, will amplify the need for improved cold starting. He feels that progress, while satisfactory, must be steadily maintained.

War Bearings Show Success

Digest of paper

by R. A. WATSON
Federal-Mogul Corp.

■ Northwest, Sept. 15

(*Paper entitled "Bearing Developments Resulting from Restrictions of Materials"*)

A MINOR revolution in sleeve type bearings has resulted from wartime restrictions on materials, Mr. Watson pointed out. War needs calling for higher volume production, and inadequate supplies of domestic and imported ores, stimulated the development of suitable substitutes, many of which have proved unexpectedly good.

When the war came, he reminded the meeting, most of the ingredients for bearings went on the critical list. Tin and cadmium were available only for vital war items. At the same time, he said, automotive units indirectly connected with the war effort had to be kept in repair and running.

Demand became more and more urgent while raw materials grew scarcer, he said. There were increasing demands on the industry to provide sleeve type bearings and bushings for tank, truck, ordnance and aircraft uses. New and much more precise parts had to be produced, with the attendant requirement for expanded facilities and additional experimentation.

Experimental and research departments were constantly at work trying to find less critical materials which would have better bearing characteristics than known substitutes. Practically nothing is known, he explained, about what makes one metal or combination of metals more suitable as bearing material than another. Theories are many and often antithetical. There is no universal alloy; an alloy ideal for one application may not be good when different operating conditions obtain.

A sleeve bearing, Mr. Watson pointed out, must have a variety of characteristics in addition to frictional resistance and good load carrying ability. It should have slight plastic flow tendencies so that the bearing surface will conform to the shaft contour and adjust slight misalignments. It should be capable of absorbing small particles of foreign matter out of the oil stream. It should resist corrosion from acids formed in oils under extreme operating conditions. Subjected to temperatures above normal, it should have a high melting point, or be so designed as not to weaken structurally.

Admitting that perfection in all these aspects is a good deal to ask of any bearing, Mr. Watson nevertheless is encouraged by progress already made in advancing bearing materials . . . improving old alloys and introducing new ones.

Important new developments in bearing art, he said, have been the high lead babbit with a hardener of arsenic; the use of calcium, valuable chiefly for availability combined with adequate performance; copper and lead on steel, adapting the art of powder metallurgy to bearings; silver bearings, important to aircraft during the war, but expensive for commercial use; grid type bearings, still in the experimental stage; aluminum-tin bearings, which show too high a coefficient of expansion; and steel-backed aluminum-tin bearings, which correct this weakness, and have the same advantages of wear, conformability, and dirt resistance.

Needs of present-day designs of industrial installations and prime movers can be adequately supplied by present available materials, Mr. Watson said. This will, however, by no means halt the search for the ideal bearing.

Streamlined Diesels Herald Rail Progress

Excerpts from paper

by ROBERT ALDAG, JR.
Chicago, Burlington & Quincy Railroad Co.

■ Chicago, Oct. 9

(*Paper entitled "Diesel-Electric Locomotive Operation"*)

NEW streamlined cars and diesel locomotives symbolize a modernization program that has been going on throughout the railroad industry since 1923. This program, which was conceived to increase the efficiency of railroad operations, is one for which the railroads have spent over eleven billion dollars in capital expenditures.

Railroads, in 1944, hauled nearly three-fourths of the total freight traffic of the nation. This railroad freight traffic was nearly twice that which was handled by the railroads in the war year 1918, yet was moved in 600,000 fewer freight cars and by 21,000 fewer locomotives.

With one-third fewer passenger cars the railroads, in 1944, moved more than twice as much passenger traffic as in 1918, an actual increase of 123%. This traffic was by far the greatest in any year in railroad history.

Diesel locomotive has done a tremendous job percentagewise, and has exhibited a high factor of reliability at a time when the entire railroad plant was operating under greatly increased loads and at an accelerated pace. What are the factors that have made this performance possible?

When we speak of performance we think of two distinct parts. One part is the locomotive's ability to do a certain amount of work in an allotted time on a given run. The other is that quality of the locomotive which keeps it on the job a high percentage of the time.

At the time of its introduction, the diesel-electric locomotive was popularly a synonym for the high-speed streamlined train. This was a natural situation because of the limitation of steam locomotives for that kind of operation.

Chart I is a plot of tractive effort versus

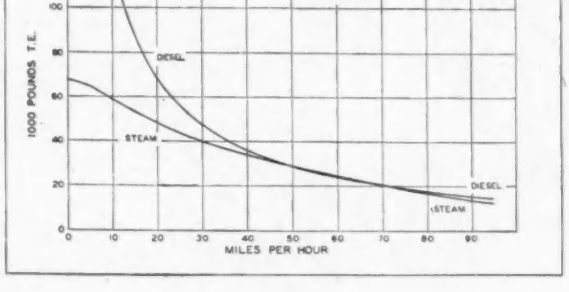


Chart 1—Comparison of torque-speed characteristics of steam engine and electric motor

speed. The steam locomotive represented is a typical modern dual service design of 4-8-4 wheel arrangement. The diesel-electric is also typical and is designed for dual service. This chart compares the torque-speed characteristics of a steam engine and an electric motor, each supplied by a constant power source, and each developing about the same tractive horsepower.

At starting, the steam engine torque is governed by the cylinder and drive wheel dimensions. From starting to about 40 mph the steam engine uses steam at the evaporative capacity of the boiler with increasing efficiency so that at 40 mph the engine output has a very close relationship to the boiler rating. This close relationship of cylinder horsepower to potential boiler horsepower continues with increasing speed until the engine is running about 75 mph. At this point the cylinder output gradually becomes a function of valve capacity. It is highly probable that recent valve developments will lift this end of the curve for the steam locomotives; however, we still have a large and very important part of the operating range, from starting to 40 mph, in which the steam engine cannot develop the available boiler horsepower.

Low Speed Performance Described

The electric motor, on the other hand, can develop a high percentage of available horsepower at all speeds, and this has a marked effect on the respective production rates of the two locomotives. As an extreme example, this diesel-electric will operate at 20 mph against a total train resistance that would stall this steam locomotive.

One normally expects, in discussing modern railroading, that speeds above 40 mph would be of chief interest; therefore the emphasis which has been put on performance below 40 mph may appear to be aside from the point. However, the actual goal we are striving toward is reduction in overall time. The electric drive can pick up some large chunks of time in the lower speed range.

Superiority of the electric drive in the low speed range also manifests itself in quicker acceleration to operating speeds in all classes of service. This is particularly noticeable in passenger service because it permits reduction in overall time without increasing top operating speeds.

There are, however, limitations peculiar to the electric transmission which affect the flexibility of the diesel-electric and, for that matter, all electric locomotives to a certain extent. At low speeds motor currents are high and the temperature rise of the motor windings is rapid enough to reach the limit for present insulation materials and soldered joints in a relatively short period of time. At high speeds the peripheral speed of the motor armature governs.

Thus for any given traction motor we have a definitely limited speed range through which we can operate at will. To illustrate this, the diesel-electric represented on Chart I cannot be operated over 95 mph, and can only be operated for limited periods below 20 mph. Violation of these limits can result in heavy damage and expensive repairs. The wider this range can be made, the greater the utility of the traction motor, hence the locomotive, in all classes of service. This is one of the most important problems confronting our locomotive builders today.

Other Advantages Recorded

One of the outstanding characteristics of the diesel engine is its relatively high thermal efficiency, in the neighborhood of 30%. The effect of this is not fully appreciated until we look at the fuel itself. The fuel has a high specific heat content, is easy and clean to handle, and requires the simplest facilities for storage and delivery to the locomotive. High thermal efficiency and high specific heat content combine to require remarkably low weights of fuel supply carried on the locomotive, and, of equal importance, less fuel weight handled by the railroad per installed horsepower. This weight factor is the principal source of fuel cost savings in favor of the diesel.

All diesel engines have the advantage of low fuel weight; however, the engine itself was not fully adaptable to railroad service in appreciable horsepower sizes until the successful development of a two-cycle design, and, later, comparable four-cycle machines. The two-cycle engine was itself relatively light and developed its full rated horsepower at a speed that permitted conveniently sized electrical machinery. Around this nucleus it was possible to build a locomotive with something less than conventional dimension and considerably fewer pounds per tractive horsepower.

The second part of performance is availability, that quality of the locomotive which keeps it on the job a high percentage of the time, and is the advantage most stressed in favor of the diesel-electric locomotive. This advantage arises not from a great difference in the quantity or quality of maintenance required, but rather from the kind of work involved and the advantages inherent in the general arrangement of the diesel-electric locomotive.

Diesel locomotive also has an advantage as regards out of service time for general repairs, because these locomotives run from four to five times as many miles as most modern steam locomotives do between general repairs. This and the advantage of progressive maintenance render the diesel locomotive available for approximately 77% more miles per locomotive per month than modern steam locomotives in passenger service. Thus four diesel locomotives can replace seven modern steam locomotives in this particular heavy passenger service.

It has been shown that the diesel-electric locomotive is a combination of the highly efficient and reliable diesel engine and the very much desired electric transmission of power for traction. This is the basic reason for the sturdy wartime performance of these machines.

The diesel-electric power unit will be projected into future developments which will render it an even more effective tool for the production of the progressive rail transportation of tomorrow.

Jet Propulsion

continued from page 28

seen that the two types are not suited to the same type of aerial combat. Each would lose to the other in different situations and each would have certain advantages in certain types of attack (fighter against bomber) on other aircraft. The combination used in the FR-1 gives fighter characteristics which are very good for a variety of situations.

The conventional engine-propeller combination has been found to stand up under almost unbelievable punishment from enemy fire. Records are common where excessive damage to the engine itself as well as to cowling and accessories did not prevent return to base. Use of the jet propulsion planes was not extensive enough to permit gathering of comprehensive statistics, but there seems to be reason to believe that the jet propulsion engine will not stand up under as severe punishment as the conventional engine. The FR-1, with its jet propulsion engine behind the pilot, has the same element of danger to the pilot as has been encountered in pusher planes of other types. In the event of an impending crash, the pilot has little choice except to bail out. But, of course, this is considered proper procedure in any military (expendable) airplane.

The specific fuel consumption of the jet propulsion engine is much higher than that of the conventional engine over practically the entire speed range of present-day airplanes. For normal cruising airspeed, 200 to 350 mph, the difference is so great as to prohibit the use of jet propulsion engines for long flights. For short flights the lighter weight of the jet propulsion engine allows a greater weight of fuel, so that for comparatively short flights, and particularly where high speed is essential, the jet propulsion engine has distinct advantages.

Prospects for the future:

It seems that economy will dictate continued use of conventional engine-propeller powered planes for the immediate future, except for special purpose military uses. The question of high speeds involves many complex aerodynamic problems. If airplane designers can manage to successfully get airplanes through the compressibility range (sonic speed), there seems little doubt that jet propulsion engines will be required. However, the problem of attaining these speeds is by no means simple. Increase in drag continues at least to the sonic region, if not beyond. Thus power much greater than anything used to date will be necessary if airplanes in their present form are used. The problem of control at such speeds seems to be another very great question. It appears that control forces and perhaps wing lift itself are subject to drastic changes in this speed range. There are, therefore, plenty of problems in the future for aeronautical engineers and for powerplant engineers.

Focus on Function for Better Fueling

Digest of paper
by J. E. KNIGHT and C. H. BAXLEY
Intava, Inc.

■ So. California, Oct. 4

(Paper entitled "Modern Aircraft Refueling")

GIANT planes now being designed will present new problems for joint action by airline operators, fuel suppliers and plane manufacturers, the authors predict. Even now, although considerable progress has been made in solving present problems, minor difficulties persist, and the major issue of perfecting an under-wing fueling system is still to be dealt with.

Examination into the important items to be considered in designing and installing stationary and mobile equipment for fueling in an airport, they reported, shows that the six most important factors are

1. Quantity of fuel and necessary rate of supply.
2. Most economical size, type, and location of storage tanks on the airport.
3. Method of transporting fuel from supply source to airport.
4. Number and sizes of aircraft for fueling.
5. Year-round weather conditions.
6. Soil characteristics, and so on.

Delivery rates generally accepted, they said, have been shown to be equivalent to those on the accompanying diagram: a rate of 20-25 gpm suffices for the small privately owned plane; aircraft of the DC-3 or Lockheed Lodestar size can be serviced at a maximum rate of 50-75 gpm; DC-4 or Constellation-size aircraft require a delivery rate of 100 or even 150 gpm to keep the refueling time short; and anticipated larger aircraft will require rates of 200 gpm or more.

Innovations

Constant efforts to improve delivery rate, ease of fueling, safety, and so on, they said, have produced a number of significant developments. Specialized designs intended to meet varying requirements of different sized airports and aircraft include

Cabinets such as the Serv-a-Plane for fueling private planes.

Standard 2000 gal truck, equipped now with a dual pumping, filtering and metering system, with nozzle delivery rate of 50-75 gpm.

Small trailer units of 600 gal tank capacity.

Semi-trailer tank truck with capacity of 2480 gal.

New 2-in. nozzle which relieves shock and also cuts nozzle velocity to a minimum.

Separators, important in designing underground systems, to eliminate water and foreign particles from the fuel. Separators usually are installed in pairs . . . two for each grade of fuel, so that one can be cleaned while the other operates. In one case cited, four separators have handled up to two million gal per month of 91 and 100 octane fuel, freeing it of water and rust.

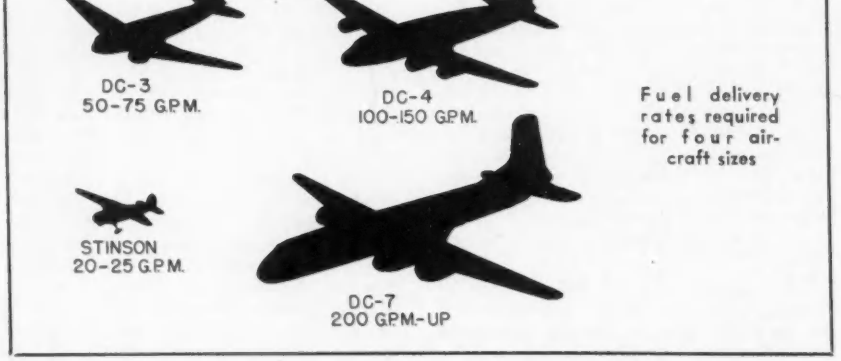
Complete fueling installation described as particularly effective for larger commercial and international airports is an underground pipeline system with properly spaced hydrant valve connections, used in conjunction with a servicing unit.

"Servicer" is a self-propelled unit with two complete pumping systems, air eliminators, strainers, meters and filters. Suction hoses are 2½ in. in diameter, 100 ft in length. Reel is fitted with a self-leveling rewind device and hydraulic rewind motor. Safety device automatically disengages the clutch and sets the brake when hose is properly attached to hydrant.

Pumps are of the positive displacement type designed for handling gasoline, and are driven by a split-shaft power takeoff from the truck engine drive. Meters are fitted with an Auto-Stop valve to automatically shut off flow at the required delivery.

Two-in. delivery hoses and nozzles are used to deliver up to 150 gpm. Easier handling of equipment is accomplished by means of a hydraulic telescopic hoist with a platform which can be raised to 15 ft above ground.

This method of pumping directly from bulk storage tanks into aircraft, the authors said, allows the delivery of large quantities of fuel in a short space of time, with very little confusion or interference with other operations in progress.



Economy to Dictate Future Fuel Trends

Digest of talk
by ARCH L. FOSTER
Petroleum Publishing Co.

■ Kansas City, Nov. 13

(Summary of ideas expressed by Mr. Foster in his talk on "Future Motor Fuels and their Economics")

MOTOR and other fuels of the postwar period will take advantage of what has been learned about fuel qualities, but economics must rule in their manufacture, more than ever before. Our present cars and those which will come off the production line in 1946 can utilize perfectly the types of fuel which were extant as prewar products. As engines are built which can take advantage of higher octane rating and other qualities, those qualities may be upped economically; this will be done by refiners.

Refiners will, in the main, bring on themselves the octane race which appears now to be inevitable. The automotive industry for the next year or two will not force serious raising of motor fuel qualities; later our automotive industry may and probably will indulge in an "octane race" in an effort to improve sales appeal, but this will come, probably, only after the automobile market is fairly well saturated. Until then the petroleum, and not the automotive industry, will be responsible for initiating its own octane race.

If octane numbers are raised above about 78 for house-brand motor fuels, it is necessary for the refiner to adopt catalytic cracking to produce fuels of that quality or higher. To do this the economies of such fuels must be favorable or the refiner cannot operate. Catalytic cracking is more expensive than thermal cracking, so the refiner must receive higher prices if he is to remain solvent. The refiner of the 1920's and 1930's had usually only about four components from which to make up his gasolines: straightrun and thermally cracked naphthas, natural gasoline, reformed naphthas, and, of course, tetra-ethyl lead and polymer gasoline, added during the last decade. At present and in the future he will have at least six, sometimes seven, components: thermally cracked, thermally reformed, and straight-run naphthas; catalytically cracked and catalytically reformed naphthas; polymer gasoline and natural gasoline. These components range from about 60 octane number to nearly 100 octane number, blending value, and from them motor fuels up to 87-90 octane rating may be produced with reasonable economy, but not at the refinery prices which prevailed during most of the decade before World War II.

News..

..OF THE SOCIETY

Crawford Succeeds Buckendale As Technical Board Chairman

J. M. CRAWFORD, 1945 President of the Society, has been named chairman of the SAE Technical Board for 1946.

Organizational problems of the Board, which the SAE Council has made responsible for all technical committee activities of the Society, were largely completed at its meeting held in Detroit on Jan. 10 during Annual Meeting week. Rules and regulations to serve as guide posts for the operations of the Board and its Committees were adopted. In addition, substantial progress was made in realigning the Society's technical committee structure to fit it into the Board's procedures.

A large group of standards developed by the Society's committees was approved for publication in the 1946 Handbook. Many of the Divisions of the former General Standards Committee were reconstituted as committees of the Board and their scope broadened to include technical work other than standardization. The Transportation Division was transferred to the jurisdiction of the T & M Technical Committee and the Tractor and Equipment Division to the new Tractor Technical Committee which is to succeed the Tractor War Emergency Committee.

Assignments Made

G. W. Laurie was named sponsor of a project which will work on the development of truck nomenclature. J. M. Crawford accepted the sponsorship for a small committee which will study and report on the handling of screw thread standardization problems which promise to bulk large at an early date both nationally and internationally. The Committee, which will work under Mr. Crawford's sponsorship, consists of W. L. Barth, Gustaf Carvelli and H. A. Marchant. The Board voted to request the American Standards Association to invite the Anti-Friction Bearing Manufacturers Association to become a cosponsor of the ASA Sectional Committee on Ball and Roller Bearing Standards. Future relationships with Army Ordnance were discussed in a preliminary way following informal conferences with Army officials.

The appointment of J. H. Hunt as sponsor on the bumper standardization project, which was undertaken at the request of the Engineering Liaison Committee of the Automobile Manufacturers Association, was confirmed.

The following were elected to serve with Chairman Crawford as the Board's Executive Committee: B. B. Bachman, G. W. Laurie, Erle Martin, R. H. McCarroll and J. C. Zeder.

J. M. Crawford, left, retiring SAE President, who was appointed chairman of the SAE Technical Board, going over the Board's business with SAE President L. Ray Buckendale, former head of the Society's top engineering group

Design Courses Offered

THROUGH the Passenger Car Body Activity, SAE has assumed cosponsorship with the University of Michigan of a course in body engineering to be established at the University. The course is to be operated under the University's Extension Department.

Designed for men with some drafting experience interested in advanced body design work, the program covers instruction in the theory and practice of body engineering, including the fundamentals of descriptive geometry, art and styling, and body design.

Organization of the program has been accomplished with the help of a steering committee of leading body engineers, headed by Walter T. Fishleigh, consulting engineer. Instruction will be given by University of Michigan faculty or outstanding men in the field of body design.

Rambling Through Section Reports

HOW engineers of the Eighth Air Force combined the cunning of fictuonal detectives with technical ingenuity was described Dec. 13 by Col. B. S. Kelsey, head of that AAF field modification team in Europe, before an audience of more than 400 members and guests of **METROPOLITAN SECTION** in Hotel Pennsylvania. Prime difficulty, the speaker and Lt.-Col. R. W. Bushing, an associate now also assigned to Wright Field, said, was to obtain precise descriptions of failures from combat-weary fliers. "It is impossible to design combat equipment that can remain unchanged, because of the constant change in tactical requirements of airplanes in war," the Colonel said. Thus, he pointed out, these modification teams were a prime requisite, and actually saved thousands of lives and hundreds of bombers and fighters, although the groups were underequipped and understaffed. He lauded the cooperation of industry engineers who formed a part of these "quick and dirty" groups. Robert Cole, Wright Aeronautical Corp., did a masterful commentary with several German films showing German developments in jet propulsion. He returned recently from a technical mission to that country.

Carl M. Berry, acting chairman for the Dec. 9 meeting of the **KANSAS CITY SECTION,** was presented by Frank S. Bondor, vice chairman, with a certificate acknowledging his distinguished service in Section activities. Mr. Berry introduced Arch L. Foster, refining editor, Petroleum Publishing Co., who spoke on "Future Motor Fuels and their Economics." Mr. Foster discussed probable future trends in motor fuel development, and emphasized the important role of economics in determining the rate and volume of change.

Col. Allison Miller, District Engineer, described at **DETROIT SECTION** Nov. 12 meeting the work of the Corps of Engineers in improving the connecting channels of the Great Lakes. His story went back to the seventeenth century, when natural channels provided adequate highways into the interior, and climaxed in an account of the tremendous wartime achievement of providing means for water shipment of iron ore for military use.

"Report on Jet Propulsion," a Bell Aircraft Corp. film picturing the development and performance of the jet-propelled Bell Airacomet, was shown at **SYRACUSE SECTION** meeting, Dec. 12. Speaker of the evening was Prof. C. W. Terry, head of the Department of Aeronautical Engineering at Cornell University, who talked on "Jet-Propeller Combinations versus Conventional Propulsion Systems for Airplanes." (See p. 28 for digest.)

Wide use of jet propulsion is still quite far in the future, according to H. J. Clyman, Westinghouse Electric Corp. Addressing the **PHILADELPHIA SECTION** on Dec. 12 on "Jet Propulsion and Gas Turbines in Aviation," Mr. Clyman illustrated with diagrams and photographs various types and sizes of gas turbines, and showed curves of performance, efficiency, and so on. The discussion period, comprising questions about lubrication, thermal efficiencies, cost, weight, and practicability of the engine for over-the-road vehicle use, emphasized the relatively early stage of jet propulsion development.

Thesis of a paper on "Automatic and Semi-Automatic Transmissions," by Harry R. Greenlee, L.G.S. Spring Clutch Corp., was "an automatic or power shifted transmission can be designed with the aid of today's manufacturing technique and with fundamentals most generally known and in use." Speaking at the **INDIANA SECTION** Dec. 13 meeting, Mr. Greenlee further stated that such a transmission will be capable of upshift or downshift, under full load, and without overlapping or breaking the drive line. By way of proof, he showed in slides and charts several groups of such known devices, and the means of changing them into entirely satisfactory smooth acting transmissions. Asked by Lee Oldfield how doubting drivers would be handled, Mr. Clyman said that there were cars equipped with automatic transmissions which also had a small device on the dash for manual shifting. Mr. Oldfield thereupon suggested a non-functional device on the dash to give the driver the illusion of shifting, while the automatic transmission actually did the job.

Fundamentals of grease composition, manufacture, and service use were discussed at **NORTHERN CALIFORNIA SECTION** meeting, December 12, by L. W. McLennan, of the Research Department, Union Oil Co. of California. In his talk on "Lubricating Oil Greases," Mr. McLennan said that while it is desirable to use lubricating oil where possible, greases nevertheless are useful because they stay put, and can be used where it is not possible to supply a steady stream of oil. He explained that greases stick because they consist of lubricating oil trapped in a network of small soap crystals. He also discussed various kinds of greases and their advantages, and different manufacturing processes used in making greases.

SAE JOURNAL FIELD EDITORS

Baltimore – Webster H. Francis, Jr.
Buffalo – No Appointment
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cincinnati – Charles W. Coote
Cleveland – Richard E. Brown
Dayton – W. D. Hazlett
Detroit – W. F. Sherman
Hawaiian – Al Molloy
– Harlow Hyde
Kansas City – Harold F. Twyman
Metropolitan – Duis W. Meador
Mid-Continent – No Appointment
Milwaukee – L. A. Wilson
New England – Arnold R. Okuro
No. California – J. H. MacPherson
Northwest – No Appointment
Oregon – No Appointment
Peoria – No Appointment
Philadelphia – Laurence Cooper
Pittsburgh – Murray Fahnestock
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San Diego Division – Grant B. Hodgson
So. New England – Claude O. Broden
Syracuse – No Appointment
Texas – Thomas Ashley
Washington – E. K. Owens
Western Michigan – E. M. Jacoby
Wichita – No Appointment
Colorado Group – No Appointment
Mohawk-Hudson Group – No Appointment
Salt Lake Group – David Brown
Spokane Group – No Appointment
Twin City Group – George S. Johnson
Virginia Group – No Appointment

Student Branch News

General Motors Institute

Section A of the General Motors Institute SAE Branch took a field trip to the Saginaw Malleable Iron Division, General Motors Corp., on the evening of Nov. 20. Activities included a three-hour inspection trip of the plant, a short talk by one of the plant superintendents, and a light lunch.

GMI students discovered that this division of General Motors supplies approximately 80% of the malleable iron produced in the United States and a substantial proportion of the world production.

Students were interested in learning of the development and production of armasteel, which is used in machine gun parts and various peacetime products.

Massachusetts Institute of Technology

A field trip to Pratt and Whitney Aircraft Division was staged by the SAE Branch of Massachusetts Institute of Technology on Dec. 11, in conjunction with the Student Branch of the Institute of Aeronautical Sciences.

The group, accompanied by Prof. C. Fayette Taylor, professor of automotive engineering and director of Sloan Laboratories

of MIT, left South Station, Boston, at 8:00 a.m. On arrival in Hartford it was met by Frank W. Powers, engineering section at Pratt and Whitney, who acted as guide. A chartered bus drove the group out to the plant where a photographer took pictures of the "gang" before it went on a comprehensive tour of the new wind tunnel.

After lunch at one of the company's cafeterias, the group was shown through the new Installations Laboratory, the Static Tests, and the Experimental Laboratories. In the late afternoon everyone had a look at several of the test cells in which models of the new Wasp "Major" were being tested.

MIT students are looking forward to more of such projects.

College of the City of New York

"Aircraft Control Surfaces" was the title of a paper presented before the CCNY SAE Branch on Dec. 12 by W. K. Bullivant, Grumman Aircraft Corp.

In reviewing the control situation Mr. Bullivant noted that due to increased speed, larger control areas, and larger chords, stick forces necessary to operate controls have increased some thirty-fold in the past 10 years. He showed with sketches how these forces are counterbalanced to bring the stick forces down to approximately 20 pounds.

The speaker described the spring tab balanced surface and the internal seal nose surface currently used in the Mustang fighter plane, and noted limiting phenomena such as flutter and buffeting.

The discussion was restricted to manually operated systems, with only a few words on boosters, which seem to find favor only on very large craft.

John W. Lane, assistant chief automotive engineer, Socony Vacuum Oil Co., spoke on automobile lubricants at the Jan. 2 meeting of the CCNY SAE Branch.

Mr. Lane started the evening by placing some oil in a tall graduate and allowing nitrogen to bubble into the oil. Eventually, the foam head on the oil caused by the bubbles nearly overflowed the graduate. One drop of a secret additive changed the surface tension of the oil and all the foam collapsed.

In this manner the speaker brought out the major point that not only are the lubricating properties of oils important, but also the starting, flowing, wearing, and economy properties. An oil which does not foam will not as easily be lost through the breather.

In another demonstration similar oils in bottles with some fine sediment at the bottom were shaken. One oil had an additive which made it detergent, and at the end of the evening that oil had all the small particles in suspension, while the non-detergent oil was clear, the sediment having settled to the bottom. With detergent oils there should be less wear, because the very small particles in suspension cannot harm the bearings, whereas the sediment of ordinary oil can clog oil passages and score bearings.

Many slides showed how engine parts were cleaned after a detergent oil was added. The slides also showed various engine failures initially blamed on the oil but later proved to come from many other sources.

In describing the lubricants required in different parts of an automobile, from greases to machine oils, Mr. Lane declared that many present problems will be solved by the future lubricants which are being designed to have higher viscosity indices and wider ranges of application.

During the extensive question period the

SAE Aero Standards Program Covers Whole Industry Range

PLANS for peacetime aeronautical standardization activities were completed and approved at the meeting of the SAE Aeronautics Division on Wednesday, Jan. 9. Emphasis will be placed on work and standards necessary for increasing the utility of commercial air transports and the personal airplane.

On the basis of requests received from the engine manufacturers, two new committees on turbine engines and low horsepower engines were established. All activities pertaining to standardization of aircraft engine accessory mountings and drives are to be handled under the reorganized committee on components and accessories. Work already under way on standard parts, screw threads and fastenings, involute splines, small engine propeller shafts and engine maintenance tools is to be continued under the existing committees of the Aircraft Engine Subdivision.

Propeller standardization activities to be continued include propeller clearance envelopes, governor mounting gaskets, necessary revisions to single and dual rotation propeller shaft ends, terminology of dual and coaxial rotation propellers, control of two speed gears and buttress threads. Studies pertaining to revisions of the No. 40 and No. 50 size shafts to incorporate involute splines for purposes of interchangeability with English standards are to be continued. These projects are to be handled by a committee concerned with large propellers, another committee concerned with small propellers and the already existing committee on buttress threads.

The Accessories and Equipment Subdivision is to continue an aggressive standardization program on electrical and radio equipment; hydraulic equipment; wheels, brakes, axles and shock struts; air conditioning equipment; instruments and heat transfer units. These committees will also undertake, upon the request of either the Government or industry, comprehensive technical reviews of proposed specifications or standards and to submit committee reports of this work, including committee's technical recommendations.

The development of new and revised Aeronautical Material Specifications (AMS) which have been so valuable during the war is to be continued through the joint efforts of personnel from the airplane and aircraft engine, propeller and accessory manufacturers, airline operators and the Government.

Work on the expansion of the drafting room manual to include practices of the Aircraft Engine, Propeller and Accessory manufacturers as well as the airline operators is to be continued by the Special Aircraft Projects Subdivision. Other projects to be handled by this subdivision are those relating to helicopters and aircraft bearings and lubricants. All problems relating to the preservation and packaging of aeronautical equipment including engines, propellers, accessories and airframes spare parts will be assigned to a reorganized committee to be sponsored by this subdivision.

The activities of the Society will be continued by an organization essentially the same as that found so successful during the war which consisted of the Aircraft Engine Subdivision with C. E. Mines, chairman, the Accessories and Equipment Subdivision with W. C. Lawrence, chairman, the Propeller Subdivision with Erle Martin, chairman, the M & P Coordinating Subdivision with J. B. Johnson, chairman, and the Special Aircraft Projects Subdivision with P. F. Rossmann, chairman.

SAE Aeronautics Division as now constituted includes (sitting, left to right) Vice-Chairman Arthur E. Raymond, Douglas Aircraft Co., Inc.; Chairman Arthur Nutt, Packard Motor Car Co., Aircraft Engine Division; J. D. Redding, and M. L. Stoner, SAE Staff. Standing, left to right: E. W. Rentz, Jr., SAE Staff; Erle Martin, Hamilton Standard Propellers; J. B. Johnson, Engineering Division, AAF Air Technical Service Command; R. D. Kelly, United Air Lines, Inc.; W. C. Lawrence, American Export Airlines, Inc.; Wright A. Parkins, Pratt & Whitney Aircraft; C. E. Mines, Packard Motor Car Co., Aircraft Engine Division; absent, Peter F. Rossmann, Curtiss-Wright Corp., Development Division.

SAE National Meetings for 1946

Meeting	Date	City	Hotel
● German Engineering Evaluation	March 4	Detroit	Horace H. Rackham Memorial
● Aeronautic	April 3-5	New York	New Yorker
● Summer (Semi-Annual)	June 2-7	French Lick, Ind.	French Lick Springs
● West Coast Transportation & Maintenance	Aug. 22-24	Seattle	New Washington
● Tractor	Sept. 11-12	Milwaukee	Hotel Schroeder
● Aeronautic Meeting and Aircraft Engineering Display	Oct. 3-5	Los Angeles	The Biltmore
● Transportation & Maintenance	Oct. 16-17	Chicago	Knickerbocker
● Fuels & Lubricants	Nov. 7-8	Tulsa	Mayo
● Air Transport Engineering	Dec. 2-4	Chicago	Edgewater Beach

speaker noted that the present trend is to doped up oils, with additives to better the various properties. Since good oil reclaiming devices remove all additives, leaving only clean base stock, the trend is to discontinue reclaiming oil.

Those who still use reclaimed oil, he declared, add it only as a filler between regular oil changes. This trend has been accentuated as the price of new oil, with improved oil production methods, approaches the cost of reclaiming used oil.

New officers were elected to administrate the CCNY SAE Branch at the Jan. 9 meeting. Eugene Shube was voted Branch chairman; Bernard Hurewitz, vice-chairman; Stanley Sadin, secretary; Sol Krichevsky, treasurer; and Irving Dick, field editor.

Purdue University

The SAE Student Branch at Purdue University opened activities of the current term with an election of officers. Robert L. Nelson has been elected to serve as chairman; Charles W. Kay, vice-chairman; and Herman C. Thorman, secretary-treasurer.

Fenn College

The SAE Club of Fenn College held an open meeting for engineering students and their guests on Jan. 11.

Speaker of the evening was Robert Hickel, project engineer for the National Advisory Committee for Aeronautics, member of the SAE Cleveland Section, and alumnus of Fenn College. His paper was entitled "Future Development in Aircraft Engines."

Mr. Hickel gave a thorough comparison of the present internal combustion engine, the jet engine, and the jet and propeller engines. Although the jet type of propulsion shows many possibilities in future development, he declared, a great deal of research and considerable improvement remain to be made. This is especially significant now that the war has ended and the peacetime demand for commercial aircraft will be for speedier, more powerful, and more highly efficient planes.

In the course of his address Mr. Hickel gave a description of the activities of the NACA and the fundamental research on aircraft engines carried on by the laboratory in Cleveland. The wind tunnel and refrigeration unit, he disclosed, are capable of simulating all types of flying conditions up to 20,000 ft at 500 mph.

In offering advice to the graduating engineer who is contemplating doing research work, Mr. Hickel emphasized the importance of knowing the kind of work which one likes best.

"Continue Mud Tests," TWEC Sub-Group Urges

CONTINUANCE on a long-term basis of the Army test program on the relationship between soil physical properties and vehicle performance, with members of the SAE group continuing to act in advisory capacity, has been recommended by the Mud Testing Committee of the SAE Tractor War Emergency Committee. Reporting to Lt.-Col. E. Gray at Aberdeen Proving Ground, the SAE Mud Testing group says that tests to date indicate that further prosecution of this Auburn Tillage Laboratories program will permit establishment of basic relationships to be used in modification of present vehicles or design of new ones for specified performance requirements.

The long-term program, the Mud Testing Committee believes, should have the immediate objective of refuting, modifying or confirming existing theories on the relationship of vehicle mobility and soil physical characteristics – and an ultimate objective of developing basic data on the relationship between soils and vehicles which can be used in designing tracks, wheels, and vehicle components which give satisfactory flotation and traction on the various types and conditions of terrain likely to be encountered in military operation. To achieve these aims, the committee states, arrangements would have to be made to obtain full or part-time use of the Auburn testing facilities or their equivalent for some years ahead.

The Committee's Progress Report No. 4, which contains the above recommendations, and which was submitted to the Ordnance Department last December, incorporates also specific and detailed suggestions regarding what the committee considers desirable in the way of methods and procedures in continuing the test work already under way.

Hunt Named to ASA Committee

SAE Past-President J. H. Hunt has been named SAE representative to the recently expanded Congressional Charter Committee of the American Standards Association. Past-President B. B. Bachman will serve as alternate.

Although maintaining its previously declared position in opposition to the seeking of a Congressional Charter by ASA, the Council decided at its Dec. 5, 1945, meeting to name a representative to the ASA Congressional Charter Committee as requested by the ASA.

W. J. King with Battelle

W. J. KING, author of a paper entitled "Axial vs Centrifugal Superchargers for Aircraft Engines," published in the December, 1945, issue of the SAE Journal (Transactions), has changed his position from Supercharger Engineering Division, General Electric Co., to Research Engineer, Fuels Division, Battelle Memorial Institute.

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Check List of SAE Meetings Papers

Here are listed those papers presented before National and Section Meetings of the Society of Automotive Engineers, which are still available in mimeographed form.

The SAE policy, in respect to mimeographed copies of these papers, is to make them available for at least one year after presentation.

The following papers, divided under four general headings for your convenience, are available at 25 cents each to SAE Members and 50 cents each to Non-Members. Ten or more mimeographed papers of any one title are available at reduced rates from the Special Publications Department, Society of Automotive Engineers, 29 West 39 Street, New York 18, N. Y.

NEW Papers This Month

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Alspaugh, M. L.	Gasoline Gum Tolerance of Ordnance Equipment (Report of CFR Committee)	Jan. 7-11, 46
	Brooks, D. B.	A Review of the Development of Reference Fuel Scales for Knock Rating	Jan. 7-11, 46
	Brunken, Renke	White Hydro Torque Drive	Jan. 7-11, 46
	Bryan, H. F.	Combustion in a Pre-Combustion Type Diesel Engine	Jan. 7-11, 46
	Cass, Robert	Motor Trucks of the Future	Jan. 7-11, 46
	Churchill, H. E. Delp, M. Z. Hykes, P. G.	Fundamentals of Suspensions	Jan. 7-11, 46
	Collyer, John	Outlook for Rubber for the Automotive Industry—Synthetic and Natural	Jan. 7-11, 46
	Cutrell, Lt. Col. E. A.	All-Weather Flying Facilities	Jan. 7-11, 46
	Davies, R. H.	Design of German Hydraulic Systems and their Components	Jan. 7-11, 46
	Deimel, A. H.	Performance of Hydraulic Transmissions	Jan. 7-11, 46
	Draney, J. J.	Heat Recovery as Applied to the Heating and Anti-Icing of Aircraft	Jan. 7-11, 46
	Dunning, Dr. J. R.	Development of Atomic Energy	Jan. 7-11, 46
	Fairbank, H. S.	Highways of the Future	Jan. 7-11, 46
	Gerler, Capt. W. C.	The German Jumo 004 Engine	Jan. 7-11, 46
	Gill, John	All-Weather Flying Techniques	Jan. 7-11, 46
	Hammond, C. F.	Steering as Affected by Suspension	Jan. 7-11, 46
	Haver, R. L. Goodin, H. A., Jr.	Design Trends in Aircraft Exhaust Systems	Jan. 7-11, 46
	Hawthorne, W. R.	Some Factors Affecting the Design of Jet Turbines	Jan. 7-11, 46
	Heussner, C. E. Johnson, E. T.	Substitutes for Tin in Automotive Vehicles	Jan. 7-11, 46
	James, W. S.	The Perfect Automatic Transmission	Jan. 7-11, 46
	Johnson, S., Jr.	Air Fixtures and Air Controls	Jan. 7-11, 46
	Kelly, R. D.	Review of Air Transport Developments in America	Jan. 7-11, 46
	Kirchner, O. E.	Foreign Observations	Jan. 7-11, 46
	Kratzer, J. C. Green, D. H. Williams, D. B.	New Synthetic Lubricants	Jan. 7-11, 46
	Landen, E. W.	Combustion Studies of the Diesel Engine	Jan. 7-11, 46
	Laurie, G. W. Taussig, W. A. Willett, H. L., Jr. Wilson, D. K.	Symposium—Approaches to Vehicle Retirement	Jan. 7-11, 46
	Martz, L. S. Peden, W. T.	Latest Developments in Honing Techniques	Jan. 7-11, 46
	McCain, G. L.	Engineering of Involute Splines	Jan. 7-11, 46
	McCloud, J. L.	Methods of Specifying Materials	Jan. 7-11, 46
	Miller, R. J.	Torque Converters	Jan. 7-11, 46
	Mock, F. C.	Engineering Development of the Jet Engine & Gas Turbine Burner	Jan. 7-11, 46
	O'Conner, B. E.	Damping in Suspensions	Jan. 7-11, 46
	Price, N. C.	Mechanical Design Considerations Influencing Blading Performance in Aircraft Gas Turbine Power Plants	Jan. 7-11, 46
	Quartullo, O. F.	The Driver's Comfort	Jan. 7-11, 46
	Sanders, Ray	Cleaning Symposium—How Chemistry Simplifies Automotive Cleaning Methods and Procedures	Jan. 7-11, 46
	Schilling, Robert	Flexible or Spring Medium of Suspensions	Jan. 7-11, 46
	Shoemaker, F. G. Gadebusch, H. M.	Effect of Fuel Properties on Diesel Engine Performance	Jan. 7-11, 46
	Short, Mac	An Aircraft Approach to Automobile Body Design	Jan. 7-11, 46
	Smith, L. H.	Motor Coaches of the Future	Jan. 7-11, 46
	Stout, W. B.	What Motor Cars Could Be	Jan. 7-11, 46
	Super, R. K.	Review of Brake Design and Methods of Rating Brakes for Commercial Automotive Vehicles	Jan. 7-11, 46
	Sweeney, W. J. Kunc, J. F., Jr. Morris, W. E.	Aircraft Engine Induction System Deposits	Jan. 7-11, 46
	Veal, C. B.	Philosophy of Cooperative Research	Jan. 7-11, 46
	Wolf, H. R.	Motor Oils – Regular, Premium and Heavy Duty	Jan. 7-11, 46

Papers Previously Announced

Vehicles

	Austen, Robert N.	Maintenance Engineering of Chassis Leaf Springs	May 9, 45
	Bentz, E. J. H.	Diesel Cold Starting Problems	June 11, 45
	Burke, John D.	The Practical Postwar Car – Report of Automobile Body Survey Conducted by the San Francisco Examiner	Jan. 8-12, 45
	Burkhalter, R. R.	Truck and Bus Transmissions	Oct. 10, 44
	Colby, Col. J. M.	Contribution of Industry to Ordnance Tank-Automotive Engineering	Jan. 8-12, 45
	Collins, Tom J.	Post-War Diesel Engines	Feb. 12, 45
	Colwell, A. T.	Alcohol-Water Injection	Jan. 8-12, 45
	Colwell, A. T.	Fuel Requirements for Farm Tractors	Sept. 13, 44
	Davis, Francis W.	Power Steering for Automotive Vehicles	Jan. 8-12, 45
	Fageol, L. J.	Possibilities and Limitations of Post-War Bus Design for City Transportation	Dec. 14, 44
	Fageol, F. R.	Advantages of Multi-Power Plants in Motor Buses	Jan. 8-12, 45
	Gohn, E. P.	Post War Truck Selection and Conditioning	Feb. 12, 45
	Gohn, E. P.	Cold Starting and Fleet Operation	Jan. 8-12, 45
	Herbert, Gordon	The Practical Postwar Care–Report of Automobile Body Survey	Jan. 8-12, 45
	Herold, Richard	Supercharged Two-Stroke Cycle Diesels	Nov. 9, 44
	Kettering, C. F.	Fuels and Engines for Higher Power and Greater Efficiency	Jan. 8-12, 45
	Kishline, F. F.	Probable Post-War Automobile Design Trends	Dec. 1, 44

Vehicles Continued

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Lautzenhiser, F. B.	A Non-Technical Discussion of Diesel vs. Gasoline Power Plants in Motor Trucks	Jan. 8, 45
	Loweke, E. F.	Power Brake Valves	Nov. 1, 45
	Oetzel, J. G.	Post War Brakes	May 10, 45
	Park, Bryan	Over the Road Diesel Operation	May 15, 45
	Peirce, T. H.	Bonded Rubber Torsional Vibration Dampers for Diesel Engines	Jan. 8-12, 45
	Pierce, Bert	The Practical Postwar Car	Jan. 8-12, 45
	Rendel, T. B.	Post War Internal Combustion Engines and Their Fuels	Dec. 14, 44
	Siemmons, C. O.	Rubber Tracks for Agriculture	Sept. 13, 45
	Taylor, C. Fayette	Effect of Engine Exhaust Pressure on the Performance of Compressor Turbine Units	Oct. 4, 45
	Twyman, L. R.	Hydraulics as Applied to Tractors and Farm Machinery	Sept. 13, 45
	Vincent, E. T.	Piston Development Review	Jan. 8-12, 45
	Watson, R. A.	Bearing Developments Resulting from Restrictions of Materials	Sept. 15, 45
	Wilson, H. D.	Report of Automobile Body Survey Conducted by the Chicago Herald American	Jan. 8-12, 45

Aeronautics

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Bachle, C. F.	Some Possibilities of Turbine Compounding with the Piston Engine	Jan. 8-12, 45
	Beal, G. F.	Making the Cockpit Practical	Jan. 8-12, 45
	Beard, M. G.	Future Operational Requirements in Relation to Cockpit Design	Oct. 5-7, 44
	Bergen, Com. J. J.	Some Observations on the Financing of Local Air Transport	Jan. 8-12, 45
	Berry, B. M. Rollins, F. S.	Aviation Lubricating Oils	Aug. 24, 45
	Brown, Merle Hoffman, Luther Griffin, J. R., Jr.	Cockpit Lighting	Nov. 17, 44
	Campbell, Kenneth	Some Advantages and Limitations of Centrifugal and Axial Aircraft Compressors	May 7, 45
	Campbell, Kenneth	Engine Cooling Fan Theory and Practice	April 5-7, 44
	Canney, F. R.	Provisions for Overwater Operation	Dec. 3-5, 45
	Christenson, C. M.	A Report on the Nature of Ice Formation on Aircraft as Related to Airline Operations	Nov. 1, 45
	Colin, Lt. R. J., Jr.	Electronic Controls in Aircraft	Jan. 8-12, 45
	Costa, Philip J.	Detonation in Flight – Its Effect on Fuel Consumption and Engine Life	Jan. 8-12, 45
	Cunningham, J. W.	High Conductivity Cooling Fins for Aircraft Engines	May 1, 45
	Dietrich, F. J.	Aircraft Riveting and Equipment	May 1, 45
	Dolza, John	Coordination of Fluid Coupling Driven Auxiliary Supercharger Speed to Engine Manifold Pressure	Jan. 8-12, 45
	Doman, Carl T.	General Requirements for Helicopter Engines	Nov. 1, 45
	Eaton, D. C.	Cruising Economy By Use of Water Injection	Nov. 1, 45
	Edwards, M. L.	Performance of the Air Oil Separator in Engine Breather Systems	April 24, 45
	Etchells, E. B. Underwood, A. F.	Silver Bearings	May 7, 45
	Field, Howard	Reduction of Vulnerability of Aircraft Hydraulic Systems	April 19, 45
	Foster, J. N.	Application of High Production Methods to Reduced Production	Oct. 5-7, 44
	Fraas, Arthur P.	Flow Characteristics of Induction Systems	Jan. 8-12, 45
	Friedlander, J. W.	Operating Costs of Personal Airplanes	May 7, 45
	Gordon, Kenneth	Control Cabin Development	Jan. 8-12, 45
	Gregg, David	Cabin Superchargers	Oct. 5-7, 44
	Gulbransen, H. E. Capt.	Transoceanic Air Navigation	Dec. 3-5, 45
	Hanley, W. V. Hundere, A.	Economics of Airline Fuel Utilization	Nov. 1, 45
	Heino, A. F.	Airport Terminal Design	Dec. 3-5, 45
	Herrmann, K. L.	New Light Weight Power Plants for Post War Airplanes	Nov. 9, 44
	Hicks, R. D.	Service Experience with Light Aircraft Engines	May 7, 45
	Jones, Alun R.	Airplane Icing Problem and Its Alleviation through Research	Nov. 1, 45
	Kelley, Bartram	Helicopter Stability with Young's Lifting Rotor	March 19, 45
	Kelly, R. D.	A Means of Warning of Incipient Breakdown of Smooth Air Flow of Airfoil Surfaces	Oct. 5-7, 44
	Kendrick, J. B.	Applied Aero-Economics	Jan. 8-12, 45
	King, W. J.	Axial versus Centrifugal Superchargers for Aircraft Engines	May 7, 45
	Knight, J. E. Baxley, C. H.	Modern Aircraft Refueling	Oct. 4, 45
	Knight, William	Stresses in Disc Wheels	April 5-7, 44
	Landgraf, F.	Helicopter Design Problems	Nov. 1, 45
	Lingle, Col. D. G. Seitz, Capt. G. A.	Army-Navy Aeronautical Standardization	Reprinted - Nov. 43 SAE Journal
	Long, D. W. Lt. Col.	Air Transport Command Cargo Loading Experience	Dec. 3-5, 45
	Loudenslager, O. W.	Structural Model Testing	May 1, 45
	Lusk, Capt. R. J.	Protection of Electrical Systems on Military Aircraft	April 24, 45
	McFarland, F. R.	Aircraft Engine Gears	May 7, 45
	MacNeill, C. S.	Propellers and Air Transport	Nov. 17, 44
	Maloy, Raymond B.	A Resume of Desirable Characteristics for Non-Stalling, Non-Spinning Airplanes	May 7, 45
	Mentzer, W. C. Mitchell, E. C.	Cargo Tiedown and Stowage	Dec. 4-6, 44
	Messinger, B. L.	Refrigeration for Air Conditioning Pressurized Transport Aircraft	Dec. 3-5, 45
	Moreton, D. H.	Problems Involved in Airframe Lubrication	Aug. 24, 45
	Mullen, H. A. Boelter, L.	Aircraft Spotwelding at Willow Run	May 1, 45
	Nutt, Arthur	The Future of Standardization in the Aeronautical Industry	Jan. 8-12, 45
	Parks, M. J.	Cargo Airplane Accessories	Dec. 4-6, 44
	Parvin, D. R.	What About the Age of Flight? Air Transportation in the 5 years to follow the war	Jan. 5, 45
	Prewitt, R. H.	Basic Factors of Helicopter Design	Jan. 8-12, 45
	Rawdon, Herb	Wood Versus Metal Aircraft Construction	Oct. 28, 44
	Rawdon, Herb	Requirements of the Feeder Line Airplane	Dec. 4-8, 44
	Reichel, W. A.	War Lessons in Testing of Accessories and Instruments	Oct. 5-7, 44
	Richards, W. M. S.	The Prediction of Engine Cooling Requirements by a Graphical Method	Oct. 5-7, 44
	Robinson, Ray	The Postwar Market for Personal Planes	May 7, 45
	Rodriguez, D. L.	Wartime Aircraft Service Problems – Their Solution	June 19, 45
	Rowe, M. R. Ladd, G. T.	Water Injection for Aircraft Engines	Aug. 24, 45
	Rudd, J. K. Heath, Westcott	Radio Interference and the Aircraft Engine	Oct. 5-7, 44
	Saint, S. P.	A System Specification for Air Navigation and Traffic Control Development	Dec. 3-5, 45
	Schweitzer, P. H. Sharples, L. P.	S-S System of Lubrication for Aircraft Engines	Oct. 4, 45
	Sheets, J. H. MacKinney, G. W.	Reverse Thrust Propellers for Use as Landing Brakes for Large Aircraft	Oct. 5-7, 44
	Shue, G. S.	Compressibility	Sept. 19, 44
	Smith, Robert L.	Potentialities of Air Cargo as a Merchandising Aid	Jan. 11, 45
	Stafford, Paul H.	Trends in Airport Runway Design	Jan. 8-12, 45
	Streett, John W.	The Detection of Detonation and other Operating Abnormalities in Aircraft Engines by Means of Special Instrumentation	Jan. 8-12, 45
	Wachs, Miller A.	Building Utility into the Helicopter	Feb. 7, 45
	Warner, Edward	International Airworthiness Standards	Jan. 8-12, 45
	Weeks, W. L.	Factors in Aeration and Deaeration of Aircraft Engine Oil	Oct. 4, 45
	Wendell, E. E. Warden, H. H. Kerr, H. H.	Weight Reduction of Aircraft Braking System thru the Use of Reverse Thrust Propellers	Oct. 4, 45
	Williams, G. L. Miller, A. B.	Primary Balancing of Radial Engines	Jan. 8-12, 45
	Wolfe, Thomas	Shipping by Air	Dec. 4-6, 44
	Wood, Carlos Crosbere, A. B.	A Proposal for the Establishment of Commercial Air Cargo Service	Dec. 4-6, 44

Fuels and Lubricants

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Adams, E. W.	Performance Testing of Wheel-Bearing Lubricants	Nov. 6-7, 45
	Ambrose, H. A. Trautman, C. E.	Engine Oil Foaming	Jan. 8-12, 45
	Becker, C. F.	Gasolines – Past, Present, Future	Dec. 1, 44
	Berry, B. M. Rollins, F. S.	Aviation Lubricating Oils	Aug. 24, 45
	Brabbs, Lt. A. D.	Testing Heavy-Duty Lubricating Oils for Naval Service	Nov. 9-10, 44
	Brandes, Dr. O. L. Donaldson, H. H., Jr.	Use and Evaluation of Heavy Duty Engine Oils	May 9, 45
	Cattaneo, A. G. Bollo, F. G. Stanly, A. L.	A Petroleum Research Engineer's Outlook on Fuels for Conventionally Powered and Gas Turbine Aircraft	Aug. 24, 45
	Effmann, Karl H.	Engine Oil Consumption Determination	March 8, 45
	Galindo, Lt. Com. H. L.	Navy Experience With Diesel Fuels and Lubricants	May 17, 45
	Georgi, Carl W.	Detergency or Dispersancy in Heavy Duty Engine Oils	Nov. 9-10, 44
	Griep, Com. E. F. Goddin, Lt. Com. C. S.	Significance of Cetane Number in Fuels	Nov. 6-7, 45
	Holaday, W. M. Mount, W. S.	Discussing the Fuels and Lubricants Supply Problem	May 15, 45
	Kauppi, T. A. Pedersen, W. W.	Silicones as Lubricants	Nov. 6-7, 45
	Keyser, Paul V.	Progress Report on Gear Oils Projects-CRC	Jan. 8-12, 45
	Larson, M.	Diesel Fuel Additives Create New Concepts	Nov. 6-7, 45
	Penfold, Norman C.	Some Comments on Engine Testing of Heavy-Duty Oils	Nov. 9-10, 44
	Pigott, R. J. S.	Considerations Affecting Fuels and Lubrication from the War Work	Jan. 16, 45
	Ronan, J. T.	Motor Oil Performance	Dec. 11, 44
	Savard, A. J.	Fuel Vapor Recovery	Feb. 20, 45
	Tongberg, C. O. Ellis, R. E. Baxley, C. H.	Application of Heavy Duty Additives to Aviation Oils	Nov. 6-7, 45
	Wright, W. A.	A Survey of Past and Present Trends in Lubricating Oil Additives	Nov. 9-10, 44

Miscellaneous

	Aufmuth, R. B.	The Practice of Powder Metallurgy	March 12, 45
	Frye, Col. J. H.	Metallurgy of Foreign Automotive Materiel	Jan. 8-12, 45
	Jackson, P. B.	Aluminum After the War	March 14, 45
	Osborn, H. B., Jr.	Tocco Hardening	Jan. 8-12, 45
	Painter, Richard Huber, Paul	Technique for Practical High Speed Motion Pictures	Jan. 8-12, 45
	McBrearty, J. F.	Utilization of New High Strength Aluminum Alloys	Oct. 4, 45
	Miller, Roy A. Tatman, Max E.	Shop Aspects of the New High Strength Aluminum Alloys	Oct. 4, 45
	Porter, F. P.	Methods for Calculating Torsional Vibration	Jan. 8-12, 45
	Sanders, Morris	Wartime Fabric Developments of Significance to the Automotive Industry	Jan. 8-12, 45
	Somes, Howard E.	Induction Heat Treatment of Internal Surfaces as Applied to Automotive Industries	Jan. 8-12, 45
	Strothman, E. P.	Some Cases for Steel as a Material	Jan. 8-12, 45
	Riesing, E. F.	Synthetic Rubber Mechanical Parts in Present and Post-war Vehicles	Jan. 8-12, 45
	Vaughn, F. F.	Induction Hardening as Applied to Farm Machinery	Sept. 13, 45
	Zeder, J. C.	More Power to Engineering	Sept. 10, 45

Limited supply of older SAE Meetings Papers in mimeographed form is also available. A permanent file of SAE Meetings Papers is kept in the SAE Library, from which photostatic copies can be made, upon request, at cost.

SPECIAL PUBLICATIONS

		Members	Non-Members
SP - 1	Drafting Room Practice – In Relation to Interchangeable Components	$ .25	$1.00
SP - 2	Engine Deposits – Prevention and Removal	.25	1.00
SP - 3	For the Sake of Argument	.50	1.00
SP - 5	Evaluation of Effects of Torsional Vibration	5.00	10.00
SP - 7	Manual on Design and Application of Leaf Springs	1.00	2.00
SP - 9	Manual on Design and Application of Helical and Spiral Springs	.50	1.00
SP - 11	Manual on Design and Manufacture of Volute Springs	1.00	2.00
SP - 11A	Supplement to the Manual on Design and Manufacture of Volute Springs	1.50	3.00
SP - 12	SAE Journal Style Sheet	.50	1.00
SP - 18	Reclamation of Engine Valves	.50	1.00
SP - 19	Manly Engine	1.50	1.50
	Testing of Aircraft Engine Carburetors	1.50	1.50
	Preservation and Packaging of Aircraft Engine Parts	1.00	1.00

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Heads Willys-Overland

James D. Mooney

JAMES D. MOONEY has become president and chairman of the board of Willys-Overland Motors, Inc. Recently resigned as vice-president and group executive in charge of overseas operations of General Motors Corp., Mr. Mooney will make his new headquarters in Toledo in order to devote all of his time to Willys' new expansion program, which will feature the production of the Jeep, and also volume manufacture at an early date of a station wagon, two truck models, and a passenger car. A lieutenant commander in the Naval Reserve since 1937, Mr. Mooney in 1941 was made head of the production engineering section of the USN, Bureau of Aeronautics. He later served in the Advanced Base Division and was promoted to captain while in service with the 11th Amphibious Force in Europe. He was named to the staff of the chief of Naval Operations before returning to General Motors in March, 1945, and resuming his duties as vice-president, member of the administration committee, and a member of the board.

LT.-COL. HARRY O. MATHEWS has been discharged from the Army and has left the Ordnance Department at Detroit. He is now located at 600 Weatherford St., Ft. Worth, Tex. Colonel Mathews is a past-vice-president of the SAE Transportation & Maintenance Engineering Activity Committee and 1939-1940 chairman of SAE Detroit Section.

Tamagamy fishing was so good that it became odious, his golf game was too poor to keep his interest, and gardening was too hard work, so **SAM GILLESPIE** put an end to his retirement after 40 years of manufacturing and designed and built a small garden tractor and is back in harness at R. R. No. 2, West Hill, Ont., Canada. He recently sold the Kingsley Mfg. Co., Ltd., Toronto. His three-year-old son, he reports, is mowing the lawn with the tractor.

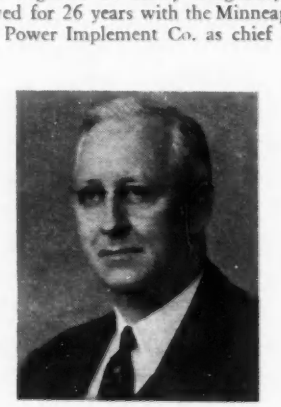
Formerly process engineer, Pioneer Engineering Mfg. Co., Detroit, **CLARENCE B. WEBB, JR.,** is now a tool designer with the Central States Engineering Corp., same city.

H. J. RITTER has been elected president and treasurer and a member of the board of Norma-Hoffmann Bearings Corp., Stamford, Conn., to succeed **O. P. WILSON,** who has resigned. Mr. Ritter, who has just recently returned to Norma-Hoffmann after his resignation in 1944, has been with the firm for 28 years, having held many company posts including that of sales manager, secretary, vice-president, and director. President of Norma-Hoffmann for six years, Mr. Wilson is also associated with the Stamford Trust Co., Ferguson Library, and is a member of the New York Advisory Board of the Reconstruction Finance Corp.

GEORGE D. SHAEFFER has been elected vice-president of Gar Wood Industries, Inc., Detroit. Mr. Shaeffer was formerly chief engineer of the company.

L. A. KRISTOFF has been appointed head of permanent mold technique and production of the John Harsch Bronze Foundry Co., Cleveland. Mr. Kristoff, who formerly had been a metallurgist with the Reynolds Metals Co., Springfield, entered the aluminum industry in 1937 as control chemist for the National Smelting Co. He later joined National Aluminum Cylinder Head Co. as chief metallurgist and gained wide recognition for the metallurgical perfection in the production of air-cooled cylinder heads for the old B-17 Flying Fortress.

ALBERT W. LAVERS has been appointed chief engineer of the Farm-Equipment Division of Graham-Paige Motors Corp. Mr. Lavers will have charge of engineering for the Rototiller, revolutionary tiller which prepares soil for planting in a single operation, the Frazer tractor, and various farm implements. Prior to joining Graham-Paige, Mr. Lavers was for almost two years the administrative engineer of Harry Ferguson, Inc. He served for 26 years with the Minneapolis-Moline Power Implement Co. as chief engineer of the automotive division. Mr. Lavers is chairman of the SAE Tractor War Emergency Committee and a member of the SAE Tractor and Farm Machinery Engineering Activity Committee.



Albert W. Lavers

J. R. FERGUSON has recently been appointed director of automotive engineering of the Packard Motor Car Co. Mr. Ferguson recently completed his duties as chief production engineer of Packard's war output of more than 55,000 aircraft engines and is now taking up his new work in the expanded peacetime development of Packard cars of the future. A graduate of the University of Michigan, he has been affiliated with the automotive industry since 1909. He joined Packard's Truck Division in 1911, and advanced to truck engineer and later chassis engineer of the passenger car division. In 1941, when Packard began production of the Rolls-Royce aircraft engine, Mr. Ferguson left his executive position as assistant chief automotive engineer to direct aircraft engine production. Following Germany's collapse, he spent two months in England, France, Germany, and Austria at the request of the ATSC studying Nazi war materials and manufacturing methods.

J. R. Ferguson

WALTER S. RAINVILLE, formerly director of the equipment and research section of the Highway Transport Department of ODT, has joined the American Transit Association, New York City, as director of research.

L. L. COLBERT has recently been appointed president of the Dodge Chicago Plant, division of the Chrysler Corp. Mr. Colbert will succeed **H. L. WECKLER,** who, in addition to his position as vice-president and general manager of the corporation, has been president of the Dodge division since 1943. Mr. Weckler resigned as president of Dodge to devote his time to his responsibilities in connection with the parent company. Mr. Colbert joined Chrysler Corp. in 1933 as a member of the Operations Committee on the staff of **K. T. KELLER.** During the next nine years he was active in the executive management of Chrysler. He was elected a vice-president of Dodge in 1935 and is also an officer in many of the company's other subsidiaries.

t SAE Members

W. M. WALWORTH has been appointed vice-president and chief engineer of Mack Mfg. Corp., New York City. He succeeds L. C. JOSEPHS, JR. Joining Mack in 1939, after serving 12 years in the engineering department of Reo Motors, Inc., Lansing, Mich., Mr. Walworth has been acting chief engineer of the corporation since March, 1945. He entered the automotive field immediately after graduation from M.I.T. in 1926. Assigned first to Mack's Allentown,

W. M. Walworth

Pa., plant, he was soon transferred to the New Brunswick, N. J., plant where he remained as executive engineer until his appointment as acting chief engineer. His headquarters will continue to be in New York City.

GAVIN W. LAURIE has been appointed by the SAE Technical Board to represent the Society on the Technical Advisory Board of the Transportation Corps of the U. S. Army. Mr. Laurie is manager of the automotive transportation section of the Atlantic Refining Co., Philadelphia. Mr. Laurie, a member of the SAE Technical Board, is a past vice-president for the SAE Transportation & Maintenance Activity.

W. W. BURROWS, SR., has been appointed vice-president and general manager of the Williamsport Paper Box Co., Inc., Williamsport, Pa. Mr. Burrows, whose resignation as chairman of SAE Syracuse Section was announced in the December, 1945, *SAE Journal*, is co-owner of the firm. Prior to the formation of the new company, Mr. Burrows was assistant to the first vice-president and chief engineer of Aircooled Motors Corp., Syracuse, N. Y.

OSCAR C. THOMAS is now serving as diesel engineer in the power and industrial equipment section of General Motors Overseas Operations, New York City. Mr. Thomas has, since 1942, been stationed in London, England, with General Motors, Ltd., as diesel service engineer.

CHARLES F. KETTERING, vice-president of General Motors Corp., and general manager of the Research Laboratories Division of the corporation, received an honorary membership in the American Society of Civil Engineers at its annual meeting, held Jan. 16-19.

JAMES H. CARMICHAEL has recently been elected executive vice-president of Pennsylvania-Central Airlines, Washington, D. C. Mr. Carmichael, a member of the Board of Directors of the airline, has been vice-president in charge of operations. Entering airline work in 1929, he flew the New York-Pittsburgh route for several years, and subsequently various other routes in the east. A pilot for Central Airlines, he remained with the new company when Pennsylvania and Central Airlines were merged in 1936, and later became chief pilot, then operations manager. Mr. Carmichael was first named a vice-president by PCA directors in 1940.

HARLEY W. DRAKE has recently joined the Valley Equipment Co., San Jose, Calif., as manager of the San Francisco branch office. The company handles construction equipment, including bulldozers, powerplants, shovels, tractors, road-graders, and trucks. Mr. Drake was formerly general manager of Lake Shore Lines, Inc., Renton, Wash.

Formerly chief technical executive, Humber, Ltd., Coventry, England, E. G. GRINHAM has recently been named technical director of the Standard Motor Co., Ltd., also in Coventry.

J. MILTON SHATZEL has been appointed works manager of the Federal Motor Truck Co., Detroit. Formerly production manager of Graham-Paige Motors Corp., Mr. Shatzel comes to the Federal organization with 13 years of experience in the automo-

J. Milton Shatzel

tive and aviation industries as a mechanical engineer and production specialist. Prior to his association with Graham-Paige, Mr. Shatzel was general manager of the National Aircraft Corp.

Col. Jesse G. Vincent

Election of SAE Past-President COL. JESSE G. VINCENT, vice-president in charge of engineering at the Packard Motor Car Co., to the board of directors was announced recently by ALVAN MACAULEY, board chairman. Colonel Vincent, who joined Packard in 1912 as chief engineer, will remain in active charge of Packard engineering. Designer of America's first 12-cyl automobile, the Packard Twin-Six, Colonel Vincent also supervised production of the first successful diesel aircraft engine. From 1905 to 1910, he was superintendent of inventions for the Burroughs Adding Machine Co., working on the company's automobiles as a side-line. When none of the automobiles seemed speedy or powerful enough to suit him, he designed his own. The side-line gradually took his entire interest, and he joined the Hudson Motor Car Co. in 1910, becoming chief engineer only a year later. Colonel Vincent joined the Army in 1917, and a few months later was promoted to lieutenant-colonel. It was then that he co-designed the Liberty Airplane engine and built an experimental station at McCook field in Dayton, Ohio. Colonel Vincent's interest in aircraft and marine engines has gone beyond the purely technical phases of their design and manufacture. His marine engines are especially noted for repeatedly bringing the "Miss America" boats to victory in the Harmsworth races.

K. D. SMITH has been appointed a vice-president and member of the Administrative Committee of the National-Standard Co., Niles, Mich. Mr. Smith, who joined the organization in 1944, has been in charge of operations at the Worcester Wire Works Division of the firm. He will make his headquarters in Akron, Ohio.

ERNEST D. BUSHONG, formerly chief procurement inspector, USAAF, Air Technical Service Command, Central District Detroit area, is now an examiner with the Reconstruction Finance Corp. Mr. Bushong transferred from AAF because of the decrease

J. Howard Pile

J. HOWARD PILE has been appointed business manager of *Fleet Owner*, New York City. Formerly vice-president and editorial director of the Chek-Chart Corp., Chicago, Mr. Pile has, during his 15 years' association with Chek-Chart, acquired a wide acquaintance in the automotive and petroleum industries. Outstanding among his accomplishments, has been the development of lubrication charts and service systems in collaboration with practically all of the major oil companies. His previous experience also includes several years as service manager of a General Motors unit, as technical editor of *Motor World*, and as associate editor of *Commercial Car Journal* and *Automobile Trade Journal*. Active in Society affairs, Mr. Pile was 1942-1943 chairman of SAE Chicago Section and is now vice-chairman of the SAE National Sections Committee and a member of the Clarkson Memorial Committee.

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in work load and contract termination of that agency. Mr. Bushong's headquarters will be the Cleveland Division of the Reconstruction Finance Corp., surplus aircraft property section. In his new position, he will assist in the disposal of U. S. Government surplus aircraft and engines.

Formerly engine design checker, Wright Aeronautical Corp., Paterson, N. J., **RICHARD R. HAROLD** is now a layout draftsman with the Eastman Kodak Co., Rochester, N. Y.

CHARLES J. KALLINICK, who had been a tool designer with the General Electric Co., Bloomfield, N. J., is now serving in a similar capacity with the Manufacturer's Equipment Co. of Paterson, N. J.

CHARLES A. TILT, formerly president of the Diamond T Motor Car Co., has been elected chairman of the Board of Directors of that firm. **C. A. PEIRCE,** formerly vice-president in charge of engineering, is now executive vice-president and **T. C. HUXLEY, JR.,** a vice-president of the Diamond T, is now general sales manager. Mr. Tilt, founder of the Diamond T organization, started his motor vehicle building career in Chicago in 1905 when he decided to make motor cars after working a few years for his father, a shoe manufacturer. His first cars were turned out by hand. Later, in 1911, the firm switched to the manufacture of trucks.

Formerly project engineer, Stout Research Division, Consolidated Vultee Aircraft Corp., Dearborn, Mich., **WILLIAM H. HORN** is now design engineer in the Experimental Engineering Division of Bendix Aviation Corp., Detroit.

C. C. CARLTON, vice-president of the Motor Wheel Corp., Lansing, Mich., delivered an address entitled "A People's War and a People's Business" at the Victory Dinner of the Automotive Council for War Production held in Detroit recently.

H. J. MARX, USNR, Bureau of Aeronautics, Washington, D. C., was recently promoted to the rank of captain. He has

Capt. H. J. Marx

been the key Navy Bureau of Aeronautics liaison officer on SAE aircraft hydraulic systems standards projects.

ROBERT L. CAMPBELL has been appointed a vice-president of Andrew Flying Services, Inc., Honolulu, T. H. He was formerly superintendent of maintenance of Hawaiian Airlines, Ltd., in Honolulu.

Formerly supervisor of precision inspection, AC Spark Plug Division, General Motors Corp., Flint, Mich., **BLY A. CORNING** is now sales director with United Machine Products & Mfg. Service, same city.

C. H. LAGE is now general works manager of the LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa. He was previously vice-president of the Universal Unit Machinery Corp., West Allis, Wis.

CHARLES M. JAMIESON, who had been chief engineer with Culver Aircraft Corp., Wichita, Kans., is now design engineer with Beech Aircraft Corp., same city.

WILLIAM J. HIGGINS is now a consulting industrial engineer with the *St. Petersburg Times* of St. Petersburg, Fla.

Formerly vice-president of the Canadian American Truck Co., Inc., New York City, **WALTER S. PEPER** is now the owner of his own firm, the Walter S. Peper Co., which manufactures truck tanks and trailerized tanks.

TED DINGER, after 17 years with the Point Spring Co., Pittsburgh, Pa., has resigned as secretary and manager to go into business for himself as a manufacturers' representative. Mr. Dinger has opened offices in Pittsburgh and will represent William and Harvey Rowland, Inc., of Philadelphia, on their line of springs, spring parts, mufflers, and wheel suspensions and parts. He will also represent the Almetal Universal Joint Co., Cleveland, and will cover the territory which includes Western Pennsylvania, Eastern Ohio, West Virginia, Virginia, and Maryland.

Formerly manager of the Protek-Plug Department, Chandler-Evans Corp., South Meriden, Conn., **H. A. LOCKWOOD** is now affiliated with Clark Metal Products, Inc., of Bridgeport, Conn.

G. G. LANGSTON, JR., is now the owner and manager of the Langston Truck & Tractor Co., Branham, Tex. Mr. Langston had been sales manager with the Lufkin Foundry & Machine Co., Trailer Division, Lufkin, Tex.

W. F. ORR, who had previously been general supervisor, manufacturing analysis section, North American Aviation, Inc., Dallas, Tex., has recently become an industrial engineer with the Basic Vegetable Products Co., Vacaville, Calif.

LLOYD W. JEDEKA has been named chief engineer of the Parker Appliance Co., Los Angeles. He was formerly division supervisor, Lockheed Aircraft Corp., Burbank, Calif.

JOHN F. TAPLIN is now a consulting engineer with offices in West Newton, Mass. Before starting his consulting office, Mr. Taplin was project engineer with the Lawrance Aeronautical Corp., Linden, N. J.

Lawrence W. Fischer

Nelson R. Brownyer

Paul V. Osborn

Lawrence W. Fischer, Nelson R. Brownyer, and Paul V. Osborn have recently been elected vice-presidents of the Timken-Detroit Axle Co., Detroit. Mr. Fischer has been continuously connected with the engineering department since he came to Timken in 1921. In his new post he will continue in an executive sales and engineering capacity. Mr. Brownyer joined Timken in 1926 as a sales engineer. Previous to that time he was chief engineer of Gotfredson Truck Corp., and prior to that was associated with the Paige Motor Car Co. Mr. Osborn joined Timken in 1941 as assistant to the vice-president. Previously he was general manager, and, later, vice-president of the Carrier Corp. of New York. In his new position he will be vice-president in charge of manufacturing at Timken

VICE-ADMIRAL **EMORY S. LAND,** USN, has become president of the Air Transport Association, Washington, D. C. He served as chairman of the SAE Aircraft Engine Subdivision in 1928-1929 when he was a captain. Recently resigned as chairman of the U. S. Maritime Commission, Admiral Land frankly admitted that he is "war-weary." In resigning from the Commission, the admiral said: "The Navy was good to me; the Government has been good to me. In return I have given my best." President Truman agreed by heaping praise on the admiral for the "colossal" undertaking in which he directed the greatest shipbuilding program in maritime history. In accepting Admiral Land's resignation, President Truman made public the admiral's letter in which he stated that "most of the major jobs, particularly war jobs, are practically finished—others are in hand in so far as practicable." The admiral said that his job had been, as the late president had predicted that it would be, a "headache." But then, he philosophized, probably most jobs worth doing were a headache. Now close to 66, Admiral Land said after serving 39 years in the Navy and nearly nine with the Maritime Commission, he felt that: "I have done my bit" and that "a younger man should take on the chores."

Formerly layout man, Chevrolet Motor Co., Detroit, **ROBERT E. KERR** is now an engine designer with the Hercules Motors Corp., Canton, Ohio.

THOMAS R. BLAKESLEE, formerly lubricating engineer, Pure Oil Co., Columbus, Ohio, is now sales engineer with the Warren Refining & Chemical Co., Cleveland.

Previously chief of the inspection and packaging branch, USAAF, St. Louis Ordnance District, Denver, Colo., **ROY F. MITCHELL** is now chief inspector for the Winter Weiss Co., same city.

Previously a student member at CCNY, **GEORGE R. SERGEANT, JR.,** USNR, is now at the U. S. Navy Midshipmen's School, New York City.

LT.-COL. G. TAYLOR MYERS has returned after three years of military service as sales manager of the Manhattan Branch of the White Motor Co. Joining the armed forces in 1942, Colonel Myers was connected with the XI Corps Headquarters. His outfit participated in the invasion of New Guinea, Netherland East Indies, and the Philippines, including the liberation of Bataan and Corregidor. Following the invasion of Morotai, he was awarded the Bronze Star. Colonel Myers had 18 years of service with the White Motor Co. prior to entering the Army. He originally became

Lt.-Col. G. Taylor Myers

sales manager of the Manhattan Branch in October, 1940, after holding the position of Cincinnati Branch manager and other important posts in the White organization.

Dwane L. Wallace and Thomas B. Salter have been elected to the Board of Directors of Cessna Aircraft Co., Wichita, Kans. Mr. Wallace, chief administrative officer, was elected president of the firm, and Mr. Salter, who is directly in charge of all engineering, was elected vice-president

Thomas B. Salter

Dwane L. Wallace

Formerly head of the design strength section, Buffalo Plant, Curtiss-Wright Corp., Airplane Division, **RICHARD K. KOEGLER** is now project engineer in the Helicopter Product Division of the Bell Aircraft Corp., Niagara Falls, N. Y.

WILLIAM J. CUMMING has joined the White Motor Co. in Cleveland as superintendent of field service operations. Formerly chief of the maintenance section of ODT, Mr. Cumming brings to White a varied background of knowledge and experience in the motor transportation field. From 1915 to 1919 he was design engineer with the Selden Motor Truck Co. of Rochester,

William J. Cumming

N. Y., and from 1919 to 1924 he served in a similar capacity with Goodyear Tire & Rubber Co. He then joined the Six Wheel Co., Philadelphia, as assistant chief engineer, later being promoted to general service manager. From 1929 until he joined the ODT in 1942, he was general superintendent of the Third Avenue Railway Co. and the Surface Transportation Corp. of New York. He is responsible for many important developments in his field and is the author of the book, "Automotive Diesel Maintenance."

R. J. CORY has severed his connection as mid-western sales representative of the Wico Electric Co., West Springfield, Mass., to join the Square D Co. of Milwaukee, Wis.

Formerly laboratory director, Propeller Division, Remington Rand, Inc., Johnson City, N. Y., **A. A. BRADD** is now associated with the Midvale Co., Philadelphia, Pa., as assistant superintendent of research.

ELMER L. HART, who was formerly field engineer with Ranger Aircraft Engines, Division of Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y., is now affiliated with Republic Aviation Corp.

Previously design engineer with Joshua Hendy Iron Works, Sunnyvale, Calif., **GEORGE K. FLOROFF** is now affiliated with Pratt & Whitney Aircraft, Division of United Aircraft Corp., East Hartford, Conn.

Formerly chief production coordinator, U. S. Army, Rochester Ordnance District, Rochester, N. Y., **ROBERT J. KELLEHER** is now works manager of the B-29 program at General Railway Signal Co., same city.

MARTIN STARK has been named technical assistant to the president of Bol, Ltd., New York City, a company dealing with optical, photographic, and electro-mechanical products. He was formerly test engineer with Wright Aeronautical Corp., Wood Ridge, N. J.

Formerly senior liaison engineer, Wright Aeronautical Corp., Cincinnati, **ROBERT L. STODDARD** is now an application engineer with the Elliott Co., Jeanette, Pa.

JAMES W. MALONE is now employed in the engineering department of the Cooper-Bessemer Corp., Mount Vernon, Ohio. Mr. Malone was previously a contract engineer, U. S. Navy, Bureau of Ships, Washington.

W. C. NEWBERG has been appointed a staff executive of the Chrysler Corp., Detroit. He was, before this appointment, chief engineer, Dodge Chicago Plant, Division of the Chrysler Corp.

Formerly chief engineer of Lights, Inc., Alhambra, Calif., **THOMAS F. MORRISSEY** has now joined the Aerco Corp., Hollydale, Calif., as production manager.

WHITNEY M. KERR, formerly manager of the public relations department, Pratt & Whitney Aircraft Corp. of Mo., Kansas City, is now sales manager for the Moore Co., same city.

I. G. BOHRMAN has recently been appointed vice-president in charge of the Radiator Division of the Perfex Corp. of Milwaukee. A veteran of 20 years in the industrial engine industry, Mr. Bohrman was associated with Hercules Motors Corp. as

I. G. Bohrman

assistant chief engineer before joining Perfex in 1941 as a sales engineer. Since that time, he has been assistant sales manager and sales manager, and was appointed man-

ALFRED P. SLOAN, JR. (right) is presented with a Hyatt roller bearing made in December, 1895, by J. J. Cless, Hyatt's oldest employee, as **H. O. K. MEISTER,** general manager of Hyatt Bearing Division of General Motors Corp., looks on at left. The presentation marked the fiftieth anniversary of the date Mr. Sloan joined the old Hyatt Bearing organization. Mr. Sloan, who was presented with the bearing on behalf of the Hyatt 25-Year Club, became general manager of Hyatt in 1897. Hyatt became a division of General Motors in 1918 when Mr. Sloan was made a GM vice-president. He became president of General Motors in 1923 and has served as chairman since 1937. Other SAE members present at the ceremony included **OTTO W. YOUNG,** chief engineer of Hyatt, and **H. K. PORTER,** general sales manager.

ager of the Radiator Division in 1943. Mr. Bohrman served for several years as a member of the Governing Board of SAE Milwaukee Section.

DONALD GREENE has been appointed assistant to the manager of the Replacement Sales Division of the Wilkening Mfg.

Donald Greene

Co., Philadelphia, Pa. Prior to joining Wilkening, Mr. Greene was for 13 years president and general manager of Don's, Inc., automotive wholesaler and Pedrick distributor of New Bedford, Mass. He has served as salesman and as division manager.

MERTON H. BLANK, formerly chief engineer of the Hydraulic Coupling Division of the American Blower Corp., has been appointed vice-president in charge of sales and engineering of the Liquid Drive Corp. The firm, formed by Mr. Blank and an associate, will specialize in the design, manufacture, and the sale of hydraulic couplings. The company will also manufacture a closed traction type of liquid coupling.

WESLEY A. STEYER, who was section head, Goodyear Aircraft Corp., Akron, Ohio, has become a designer with Northrop Aircraft, Inc., Hawthorne, Calif.

MAJOR HARRY PRICE, Ordnance Department, a member of SAE since 1930,

Major Harry Price

having completed almost four years of service in the Office of the Chief of Ordnance in Washington, D. C., and with the USAAF in Europe, is now resuming his practice of patent law in association with Dean, Fairbank & Hirsch, New York City.

Previously tire engineer with the U. S. Rubber Co., Detroit, **BRUCE D. CAULKINS** is now manager of tire engineering and service of the Atlas Supply Co., Newark, N. J.

CHARLES A. GLADDEN, JR., has been named chief engineer of Gladden-Haas, Inc., Owosso, Mich. He was formerly test engineer in the Aircraft Engine Division of Continental Motors Corp., Muskegon, Mich.

Formerly a student member at Northwestern Technical Institute, Evanston, Ill., **WARREN R. BLACK,** an ensign in the USNR, is now stationed aboard the USS Mount Vernon and may be contacted c/o Fleet Post Office, New York City.

NEIL R. McLEOD has been appointed vice-president in charge of production, Engineering Services, Inc., Tempe, Ariz. He was formerly assistant general superintendent, Airesearch Mfg. Co. of Ariz., Inc., Phoenix.

S. H. EDGE, Fighting Vehicle Design Department, British Ministry of Supply, London, England, is now engaged in assisting the work of blending tank and wheeled-vehicle programs. Mr. Edge has been with the Ministry of Supply since 1941 when he was with the Clayton Dewandre Co., Ltd. Since that time he has served as assistant director of the department of Tank Design and of technical mechanization at the Ministry.

A. L. BOND, a technician fifth grade in the U. S. Army, is now a member of the special engineer detachment at Santa Fe, N. Mex. He had been stationed at the Los Alamos Atomic Bomb Project near Santa Fe since May, 1945.

Formerly manager of the aviation engineering section, Westinghouse Electric Corp., Los Angeles, **R. W. GEMMELL** is now manager of the aircraft sales department of the same firm in Lima, Ohio.

GEORGE P. WILSON has enrolled at Tri-State College, Angola, Ind., where he is completing a course in electrical engineering. Mr. Wilson served for two and one-half years as an instructor at Pratt & Whitney Aircraft's U. S. Army and Navy Engine Training School and later was company engineer with the Amoskeag Machine Co., Manchester, N. H.

Formerly general superintendent, Vivian Diesels & Munitions, Ltd., Vancouver, B. C., Canada, **LISLE D. BYCE** is now affiliated with Canadian Fairbanks, Morse & Co., Ltd., same city.

MARVIN H. GREENWOOD has been appointed vice-president in charge of engineering and sales of Anderson, Greenwood & Co., Houston, Tex.

FORREST W. McMEANS has been appointed sales manager for the Milwaukee Hay Tool Co., Milwaukee, Wis. Mr. McMeans was formerly manager of the Detroit Sales Office, and more recently an executive assistant for the Automotive Gear Works, Inc., Richmond, Ind.

Forrest W. McMeans

M. K. MEHTA has recently joined General Motors Overseas Operations and is serving as a diesel sales engineer in India. Mr. Mehta was previously assistant design engineer with the Atlas Aircraft Products Corp., New York City.

BERNARD LAST, who was a designer (heat exchangers) with the M. W. Kellogg Co., New York City, is now design engineer and partner in Imagineering Unlimited, Rahway, N. J., a company specializing in the design and development of special purpose machinery, tools, jigs, and plastic molds.

FRANK N. SINGER, formerly captain, Ordnance Department, Columbus Depot, has returned to the American Trucking Associations, Inc., Washington. Mr. Singer was one of two officers at the Columbus Depot to receive a commendation from the Chief of Ordnance for "outstanding performance of duty . . . while serving as maintenance officer, Columbus A.S.F. Depot." While at the

Frank N. Singer

depot, his duties included the administration of a shop for maintenance and preparation for servicing the vehicles held in storage.

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ANNUAL MEETING

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beyond the point of obtaining frequencies below 55, since the slight reduction in acceleration of the sprung mass is more than offset by factors such as riding, handling, braking, car height, and economy.

Number one consideration regarding spring deflections, Mr. Pretz feels, is that under normal load the front deflection should be 10 to 20% greater than the rear deflection.

Flexible or Spring Medium of Suspensions – ROBERT SCHILLING, General Motors Corp.

COMMERCIAL applications of different types of springs have remained competitive because no one type is superior in all respects. As engineers learn more of the geometric and dynamic requirements of suspensions, the less economical springs gradually will be replaced unless their weight can be substantially reduced.

Spring efficiency, in terms of weight only, were given as:

Type	In.-lb energy per lb of spring
Leaf	300-450
Volute	500-1000
Helical, round wire, coil	700-1100
Torsion bar	1000-1500
Rubber spring in shear	2000-4000

Pointing out that it would be a mistake to rate springs on the above factor alone because it does not give the economy of space and total weight of the mechanism, the table indicates in which types the weight economy needs the most improvement.

Special credit for the excellence of American springs was given to the spring manufacturing industry, which has adopted shot peening and pre-setting – two ancient metal working practices which have come into their own in recent years.

Because the settling of rubber depends upon temperature and exercise, an automatic adjustment for standing height is highly desirable. Otherwise stresses must be kept so low that the settling remains within acceptable limits. Characteristically, the point of the rubber-to-steel bond is the weakest point.

Air was cited as the ideal springing medium. However, the problem of designing suitable containers and mechanisms is an involved one, particularly because air has practically no damping in itself. Provisions must be made to provide restrictions in the air passages so that considerable damping can be produced.

The author pointed out that in any consideration of vehicle suspension, the design engineer must keep in mind purposes other than load elasticity support. Leaf springs have been widely popular in vehicle suspension because they also often form the whole linkage of the axles or wheels to the chassis – thus saving the expense and weight of other structural members.

Proper proportioning of volute springs is important, because they inherently have a rapid rate increase toward the end of the stroke. This causes unequal stress distribution which tends to make the type uneconomical.

The coil springs are forced to deflect laterally and to twist during compression. The additional stiffness required to counteract this effect is uneconomical.

Rubber springs, used in the form of bushings, replace the main suspension bearings and thus save parts and also eliminate the need for lubrication. They also provide some insulation against noises.

Thus, the author pointed out, while the coil and volute springs need only the simplest of supports, torsion bar springs must have separate anchors which are highly stressed, leaf springs must use shackles, and rubber-air springs need their reservoirs. This being the case, investigations must be made carefully of each type of spring in terms of the installation as a whole.

DISCUSSION

Roy W. Brown, Firestone Tire & Rubber Co., emphasized the importance of dynamic characteristics, pointing out the importance of study, measure, and evaluation of complex vibration movements.

The spring medium which enables the most direct attachment, he said, is best suited for reducing unwanted secondary vibrations. Rubber, in addition to being able to store twice the in.-lb of energy per lb of spring stored by steel, has enormously greater resistance, with air, to the transmission of high-frequency vibration.

Mr. Brown suggested that aircraft undercarriage practice is worthy of attention by motor car designers.

A. S. Krotz, B. F. Goodrich Co., rates air as the best spring medium, steel as the least desirable, and rubber in an intermediate position. However, he said, the application of some types of rubber springs can be made more easily than air or steel, and, in the last analysis, selection of a material will depend as much on the designer's ingenuity in applying the spring as it will on the efficiency of any one material or inherent advantages of any one kind of spring.

Extensive progress, he said, depends upon a realistic evaluation of all materials and types of springs, and, in addition, upon a careful consideration of probable future improvements of each.

Bernhard Sterne, Chrysler Corp., agreed with Mr. Schilling that the choice of a spring type cannot properly be based on any single consideration. Even the basic criterion of energy storage per unit weight of material does not always furnish an unequivocal answer, he said, when the weight of the whole mechanism is taken into consideration.

Low cost and versatility in doubling as a structural member, he believes, have been responsible for the continued use of the leaf spring in spite of its poor showing in such comparisons.

Mr. Sterne feels that not nearly enough of the methods have been explored to obtain the load deflection curve with variable rate, but that future progress should make it possible to combine rate controlling influences of linkage and of bumper springs to restore the suspension spring to its main task of furnishing ample deflection.

Increasing the static deflection to the equivalent of the

Typical of more than 40 administrative and technical committee meetings which took place at the 1946 Annual Meeting, was this group of leading SAE T & M engineers, shown here before that Activity Committee Meeting was called to order. Seated, left to right, are: Jean Y. Ray, an SAE past vice-president, Retiring Vice-President Emil P. Gohn, and former Vice-President Ellis W. Templin. Standing are E. N. Hatch, incoming vice-president, and Warren A. Taussig, 1946 T & M Meetings chairman

Guests at the SAE Annual Meeting Dinner, Jan. 9, in the Masonic Temple, Detroit, were (left to right): A. W. Herrington, SAE past president and chairman, Marmon-Herrington Co., Inc.; A. W. Phelps, president, Oliver Corp.; R. J. Waterbury, chairman, SAE Detroit Section; C. J. Reese, president, Continental Motors Corp.; M. L. Bricker, vice-president, Ford Motor Co.; T. R. Lippard, president, Federal Motor Truck Co.; Alfred Marchev, president, Republic Aviation Corp.; SAE Past-President H. T. Woolson, Chrysler Corp.; Major-Gen. G. M. Barnes, chief of Research & Development Service, Army Ordnance Department; Henry Ford II, president, Ford Motor Co. and the principal speaker, and Toastmaster W. J. Davidson, SAE past-president and administrative officer, General Motors Corp.

ride clearance, he pointed out, results in economy of spring design, with benefits to the driver, the payload, and the life of the truck. Each increase in deflection demands a proportional weight increase because of limitations in maximum stress. On the other hand, a reduction in load rate means a reduction in stress rate, which is equivalent to a reduction in stress range for a given amplitude and therefore to an increase in fatigue life.

Damping in Suspensions – **B. E. O'CONNOR, Houde Engineering Division, Houdaille-Hershey Corp.**

THE simple principles used to indicate the direction of the experimental approach to the damping problem – which has been more extensive than the theoretical approach – were stated by Mr. O'Connor, who expressed the hope that, as the inherent damping of vehicles is decreased in the future, theory may be used to indicate quantitatively the proper amount and type of damping.

Following analysis and definition of six different types of damping, Mr. O'Connor concluded that:

1. The factors influencing the quality of a ride which are affected by the damping in the system are the acceleration and the change in acceleration of the vehicle body;

2. Damping is essential in the vicinity of resonance and for destroying free vibrations – and objectionable for all other conditions;

3. Viscous damping tends to amplify road irregularities in proportion to their severity;

4. Coulomb and degenerate viscous damping tend to amplify the effect of mild irregularities;

5. Hydraulic damping tends to amplify mild irregularities to a less extent than does viscous damping and to amplify severe irregularities to a greater extent.

Stating that the effect of temperature on the characteristics of a given damper depends on the fluid used in the damper and the type of valving, Mr. O'Connor commented that the new silicone fluids show remarkably small change in viscosity for changes in temperature. For this reason, he said, they are very excellent shock absorber fluids, although high cost prevents their use for that purpose. Mr. O'Connor has used silicone fluids successfully to produce damping by merely shearing a film of fluid between two surfaces.

DISCUSSION

R. E. Lewton, Chrysler Corp., discussed insufficiencies of damping in tires. In the rear of the present-day passenger car, he pointed out, a weight of 300 to 400 lb is suspended between the tires and the chassis springs. Irregularities of the road surface cause slight harmonic movements of the unsprung mass, which in turn are continued or even magnified by energy from the powerplant. Cyclical modifications or interruptions of road and tire contact result in a feed of energy from the powerplant in phase with the energy initiating the wheel movement. Resulting axle chatter, he said, contributes to commotion, lack of continuous stable contact with the road surface, traction difficulties, side hopping, and increased tire wear.

To correct this difficulty, he believes, more damping should be placed between the road and the unsprung mass, rather than in springs, shock absorbers, and other connections between car body and unsprung weight.

Effects of Suspension on Steering – **C. F. HAMMOND, Gemmer Mfg. Co.**

IT is best to have a slightly heavier load on the front than on the rear wheels, Mr. Hammond said, so that the slip angle on the front tires may be greater and thus produce the desirable effect of understeering. It is equally desirable, however, according to Mr. Hammond, to provide that the rear tires skid first, because directional control is lost when the front tires skid, but when the rear tires skid the car can still be controlled.

It is necessary, he pointed out, not only to coerce wheels into a satisfactory vertical movement during jounce and rebound, but also to maintain a proper relationship during pitch and roll movements.

He sees as most desirable the suspension whose requirements may be satisfied by the smallest number of linkage joints.

Some suspension designs, Mr. Hammond explained, coupled with the available space left for the steering gear and the desire not to use an idler arm and the necessary additional joints, seem to indicate that short knuckle arms are required. This introduces what Mr. Hammond branded as "two undesirable evils," namely, a shorter arm imposes a higher bearing load on the king pin both in straight-ahead driving and at the acute angles found in turning to full lock; the shorter arm amplifies any lost motion which may be in the system.

Mentioning the vast changes in steering gear ratios in recent years, Mr. Hammond said that the overall ratio is made up of the steering gear reduction and the linkage and stressed the effect of slip angle on the number of degrees a wheel has to be turned is very good reason to warrant considerable effort to keep the slip angle at minimum.

Mr. Hammond recalled that the change to independent wheel suspension was directed not only by desire for better riding qualities but also to obtain better steering control. Then he concluded by saying that: "There are conflicts between them and as we progress there must be a fair compromise – no slighting of one at the expense of the other."

DISCUSSION

Harry Hawkins, General Motors Corp., described the development of steering gears and linkages from the time, 15 years ago, when steering linkages "consisted usually of a so-called drag link and a tie rod hung onto the car without too much thought except to hope that the front wheels would turn to the right when the driver turned the steering wheel clockwise," to the present day, with its still crude and complicated designs. He reported that efficiencies now range from 60 to over 80%, however, and that much can be done to improve overall steering design through the close cooperation of all engineers concerned with automobile design and development.

Continuing, Speaker Table shown, left to right, are: J. M. Crawford, General Motors Corp., and retiring SAE president; G. T. Christopher, president, Packard Motor Car Co.; L. Ray Buckendale, SAE president-elect and vice-president in charge of engineering, Timken-Detroit Axle Co.; H. J. Kaiser, president, Henry J. Kaiser Co.; O. E. Hunt, executive vice-president, General Motors Corp.; W. A. Roberts, vice-president, Allis-Chalmers Mfg. Co.; J. W. Frazer, chairman, Graham-Paige Motors Corp.; R. H. McCarroll, executive engineer, Ford Motor Co., and L. J. Fageol, president, Twin Coach Co.

An Ideal Transmission – W. S. JAMES, Ford Motor Co.

THE requirements for an ideal transmission, as stated by Mr. James, are that it shall permit the operator to obtain at will and with natural, easy movements and the minimum of effort, the acceleration or ability to climb hills that he desires, maximum speed, or optimum fuel economy.

There are, however, other desirable characteristics that such a transmission should have. These are listed by the author as follows:

1. A neutral and reverse gear with a suitable control to permit the operator to have manual selection of neutral, forward, and reverse.

2. For descending hills a manual override on the foot accelerator control of the "total ratio." This control should permit the driver to increase the total ratio when descending grades with a closed throttle. This same control could be used to provide a low total ratio for a taxi start and for the control of the total ratio when high-speed idle is required for the choking period during starting.

3. When driving on icy roads and with low wheel torques, engine speed and total ratio should be low. Both of these conditions are favorable to safe driving.

4. When climbing slippery grades the engine speed should be low but as the grade increases the total ratio should increase to keep engine speed above 400 rpm and make it possible to apply a steady torque to the wheels at a slow car speed.

5. When wheels lock during a brake stop on slippery roads, the clutch should be disengaged or the drive line disconnected in some manner. When brakes are released and wheels again begin to turn, the clutch should be reengaged at a low total ratio, in order to have a low engine speed. If this is accomplished the feel of the foot accelerator and the operation of the car should be satisfactory.

He then listed the advantages of such an ideal transmission as being:

1. The greatest acceleration, hill-climbing ability, and top speed the engine could give would be available to the driver.

2. It would be more pleasant to drive a car with such a transmission because of the reduction in engine speed with accompanying reduction in noise and vibration.

3. The car would be easier to drive because the manipulation of a single control, the foot accelerator, would give complete control of speed under all conditions of driving except those when braking was required.

4. A smooth shift from one total ratio or gear to another would be accomplished because of the infinitely variable change of transmission ratios that could be made at any throttle opening.

5. Longer engine life would be expected because of the limit placed on maximum engine speed.

6. Fuel consumption of a car fitted with this transmission should be much less than with the conventional 3- or 4-speed transmission.

The principal disadvantages, he thought, would probably be its greater cost and weight. He felt, however, that these disadvantages would be offset by greater ease of driving and longer engine life, and also by an appreciable reduction in fuel consumption.

Torque Converters – RAYMOND J. MILLER, Bendix Aviation Corp.

PRESENT demand for automatic transmissions by bus and passenger-car manufacturers, Mr. Miller believes, will lead to increasing development of the hydraulic torque converter, thus making it desirable that automotive engineers familiarize themselves with the present and potential applications of this accessory.

Torque converters used on highway equipment, he explained, must be supplemented with a gear transmission and, in some instances, with a fluid coupling. When applied to the passenger car, it is necessary to employ a mechanical reverse gear behind the converter, and possibly even a coasting gear, for in some states it is required by law. The converter should be capable of producing sufficient torque multiplication to accelerate the vehicle satisfactorily. The figure, Mr. Miller reported, should be at least 3.5 at stall. After the car has been accelerated under full-throttle operation to the speed where the converter has reached its clutch point, that is, where the torque curve reaches 1:1 ratio, the converter should be automatically locked out of the circuit. To give satisfactory car performance, the author continued, it is also necessary that the torque ratio curve extend out to a speed ratio of 0.7-0.75 before the clutch point has been reached, for if the clutch point is substantially below these figures, there will be quite a hump effect when the engine is tied directly to the rear wheels.

Direct-drive operation can be secured in the conventional manner by employing governors, and in turn this same system will serve to disengage the direct drive when the car has reached a predetermined low speed, so that the converter may again function. The coasting gear for hill descent or for long, up-grade pulls requiring torque multiplication is manually selected. Reverse gear is also manually selected. In some heavier passenger cars, the author noted, it will be required to incorporate a mechanical kickdown gear in the transmission, which will be employed only during high-speed operation – somewhere between 40-55 mph. A torque converter employed as described, the author claimed, allows the engineer to take advantage of its good points and to overcome its deficiencies in an economical manner.

The development of the torque converter, however, the author reported, still remains a challenge to ingenuity and cost-conscious production engineers. It remains expensive to manufacture by the methods employed to date. One answer to low-cost production, he suggested, might be the fully stamped sheet metal vane and housing, although this development cannot be achieved until high-quality demand is here.

Hydraulic Transmission Performance – A. H. DEIMEL, Spicer Mfg. Corp.

PROGRESS in hydraulic transmissions for heavy-duty vehicles during the last few years was illustrated by Mr. Deimel by comparing the current Spicer Model 916 torque converter with the original European model obtained in 1933. The current model, Mr. Deimel showed, is two-thirds the overall length of the original and the maximum torque capacity and maximum torque multiplication have been greatly increased.

Meeting the objection that the smoothness of the hydraulic transmission can be obtained only at a sacrifice in fuel economy, Mr. Deimel urged that any engineering design is a compromise and that the best engineering consists in obtaining the best compromise. "Our analysis recognized," he said, "that there were losses involved in the use of any form of drive, but that these losses might not all occur in the transmission itself. It was felt that by careful consideration of all the factors involved a good compromise might be arrived at, which would have the desired result in the overall vehicle economy."

Although the transmissions described by Mr. Deimel are designed for heavy-duty vehicles, he feels sure that the principles are applicable to passenger car service as well. Experience with smooth and rapid starting and quick acceleration possible with hydraulic transmissions in heavy-duty vehicles, he said, indicates that the same features would be desirable in a passenger car transmission, particularly when considering the ease of handling of the hydraulic transmissions.

Mr. Deimel concluded that every feature must be judged by its influence on actual results obtained in the vehicle under actual operating conditions.

White Hydro Torque Drive – R. BRUNKEN, White Motor Co.

THE White hydro torque drive is a transmission utilizing new ideas as well as old, established ones in an entirely new combination, according to Mr. Brunken, who discussed this new drive in detail.

The main elements employed, he said, are a hydraulic torque converter in combination with a newly developed hydraulic coupling, and a two-speed synchromesh gear box, combined with a new automatic torque-responsive control system of the electric-pneumatic type. The result, the author continued, is a drive that relieves the driver of clutch and gear shift operations, is automatic throughout, and yet allows the driver the necessary override control.

In summary, Mr. Brunken stated that the hydro torque drive is an extremely flexible drive and "knows" exactly when to shift under all conditions and obeys the command of the driver instantly. It takes into account the accelerator position, the vehicle load, grades, and wind resistance. It is an automatic drive that becomes nonautomatic automatically. It provides the necessary override of the automatic controls simply through accelerator pedal control, reacting to the most minute change under any load condition.

A few of the many advantages claimed by the author for this drive are:

1. Hydraulic drive at all times.
2. No lag in full- or part-throttle starting.
3. Correct torque ratio available at all times.
4. Stays in low gear if desired.
5. Can be assembled and disassembled by average mechanic.

DISCUSSION

In the discussion that followed the four transmission papers, George Rothrock, Cadillac Motor Car Division, General Motors Corp., expressed the opinion that the torque converter is likely to become an integral part of many future automatic transmissions for automobiles. For this service there may be objections to the reduced mechanical efficiency of the torque converter when the static member is allowed to free wheel to give fluid coupling action. Present fluid couplings operate at about 98% efficiency, when the operating speeds are reasonably high, and the 94% mentioned by Mr. Brunken represents a serious loss. Mr. Rothrock also called attention to the inherent initial delay on acceleration, and the noticeable rise in engine speed, when a hydraulic torque converter is used.

Mr. Brunken, following a question from Dave Toot, Chrysler Corp., explained that for passenger-car use the vanes in the torque converter may need to be stampings, because of cost. Such a design may sacrifice operating efficiency.

W. M. Merrill, General Engineering and Design Co., described briefly a positive displacement hydraulic torque converter using seven cylinders of 1 in. diameter, as an alternative to the hydrokinetic type described by Mr. Deimel.

Recalling that about five years ago he talked to the SAE on automatic shifting, Karl Britton, Britton Controls, Inc., stated that at that time there was little interest in the subject, and also little conception of the requirements and the problems involved. According to Mr. Britton, all that is needed is a method of shifting the conventional type of gear box, without the use of fluid drives or complicated mechanical devices.

PASSENGER CAR BODY SESSIONS

Chairmen

J. W. Votypka — **W. T. Fishleigh**

These sessions indicated the new interest of this group in truck as well as passenger-car body problems with papers touching on body problems for both types of vehicle.

Possibilities of using aircraft experience in approaching design of future automobile bodies were thoroughly explored, as were other aspects of what future motor cars might be.

The Driver's Comfort – O. F. QUARTULLO, Visioneering Co., Inc.

DRIVERS of motor trucks are subjected to discomfort because insufficient attention has been given to the problem of providing comfortable, safe cabs, Mr. Quartullo reported. The chief difficulty appears to be limited production, which prohibits adequate expenditures for driver comfort.

Experience indicates, he said, that the truck driver should sit at the extreme left, where he will have vision at least equivalent to that of the locomotive engineman's and an unobstructed view forward and aft. This change in the location of the driver's seat may necessitate some relocation of the steering gear which, as presently mounted inside the frame, forces the driver to sit toward the center of the cab.

Standardization of safety glass at approximately 28-in. widths to meet the needs of passenger cars has penalized designers of truck cabs as well as the truck driver.

Greatest improvement in driver comfort can be made by providing, even at higher cost, seats which will handle variable weights and sizes under severe riding conditions and prolonged operation. Preferable are unit seats, with seat cushion and back moving in unison, and suspended either with shock-absorbing elements or rubber.

Steering columns, in his opinion, should be rigidly mounted on the same main frame as the steering gear, while the cab should have three-point suspension for flexibility and comfort. Side windows should have provisions for no-draft ventilation and for defrosting. Doors should be properly fitted and equipped with rubber seals. Brake and clutch pedal pressures should be equalized, and effective power steering mechanisms should be applied to trucks operated in local delivery service demanding maximums of starting, stopping, and parking.

DISCUSSION

V. H. Hoehn, U. S. Rubber Co., confirmed the need for increased comfort for the commercial vehicle driver and recommended the use of foam rubber for seating construction, especially because the cushioning design can be varied to satisfy differing requirements. Control of density during the whipping, or foaming, operations, he said, as well as coring design, have made it possible to classify foam rubber cushions in eight grades according to compression resistance, based upon the resistance at the point of 25% depression. Grade 7, he explained, is well adapted to cushions for commercial vehicles, being sufficiently soft to absorb road shocks, sufficiently hard to give the driver adequate support. Mr. Hoehn suggested that the proper foam rubber cushion for commercial vehicles should have a large number of comparatively small cores, with smaller holes penetrating the surface to assure maximum ventilation and cooling.

Equipping drivers' seats with a variable-rate spring plus shock absorber was recommended by Arthur Boor, Monroe Auto Equipment Co., who asserted that driver comfort demands both elimination of road shocks and improvement of driver seating posture. Commercial vehicles neces-

sarily use highly rated springs, he explained, and road shocks can be kept from the driver's seat only by putting a shock-absorbing device, which must be much more than a cushion, between these shocks and the driver.

Standardization of cab design to satisfy economic requirements is no excuse for driver discomfort, according to T. L. Hibbard, Ford Motor Co., who said that comfort could be built in. He added that driver comfort could be increased by installing an independently sprung, fully adjustable seat, and recommended additionally the installation of ventilation and sound-proofing.

J. W. Knopke, Chrysler Corp., insisted that passenger-car driver comfort has not yet reached the state of perfection described by Mr. Quartullo and still is the subject of continuing research. Similar interest should be taken in improving the comfort of commercial vehicle drivers, he said, particularly along the line of adapting seats to drivers. Mr. Knopke expressed the opinion that need for steering room at the left would work against moving the steering wheel to that location, and said that, at the present time, the cost of seat suspension is prohibitive.

Proper seats, adequate vision, and other factors of no great cost all would contribute to driver comfort, said J. W. Diedrich, General Motors Overseas Operations. Moving the driver's seat to the left would constitute a big improvement, he added, and still more comfort would be provided by remote control of gear-shifting, possibly through mounting gear shift levers on the steering column as presently is done in passenger cars. He recommended the installation of rests for both arms as preventive of strain upon back muscles, and described a folding rest for the right arm, similar to those now built into passenger cars, as highly satisfactory. So few trucks are owner-driven, Mr. Diedrich explained, that the pressure for improvement of driver comfort is not so great as it might be.

L. A. Stewart, Mack Manufacturing Co., characterized the truck as the workshop in which a driver spends up to eight hours daily and said the need for increased driver comfort represents a pressing problem. Cabs and seats on commercial vehicles must be built for 500,000 miles of service, he commented, yet tooling costs are not such as to prohibit standardization for comfort.

Any attempt to move the steering member to the left would create serious mechanical and cost difficulties, Mr. Stewart said, and steering column gear shifts also would be difficult to install because of varying requirements, yet are desirable. He recommended that the driver's seat should move with the cab, reporting unsatisfactory experience with flexibly and separately mounted cabs and seats, especially in the way of ride sickness.

Additionally, Mr. Stewart recommended the installation of fresh air intake heater systems to solve defrosting problems, particularly on side windows, and predicted that power steering would become more generally used. Driver comfort and safety go hand in hand, he concluded, and both are becoming more serious concerns of truck buyers.

An Aircraft Approach to Automobile Body Design — MAC SHORT, Lockheed Aircraft Corp. and W. E. MILLER, Consulting Engineer

(*Presented by Mr. Short*)

WITHOUT attempting to describe anybody's "dream car," the authors related for the possible edification of automobile designers the methods and principles which govern aircraft design.

Basic difference which makes comparison difficult, they said, is that the plane is supported by dynamic reaction on the air . . . the motor car by static reaction on the ground. This fact means that weight, strength, shape, and other characteristics of acute importance to airplane design require far less attention in automobile design.

Believing that weight does not imply strength, the authors admitted a strong preference for light metals, particularly aluminum alloys. However, they said, cost precludes complete aluminum alloy bodies for cars, since the long term cost of transportation has no significance as compared with bus and plane transportation.

For secondary body parts, hardware, and miscellaneous sheet metal parts around the body, they see a logical field for aluminum sheets and die castings. In parts such as baggage compartment lids, they believe drivers would appreciate the weight saving of aluminum.

Thoughtless application of aircraft-proven metals to automobile design may have disappointing results, they warned. How successful light metals would be, they said, is a matter for determination by experiment, with careful consideration of the ultimate value, if any, of weight saving.

Attacking the frame versus frameless question, the authors pointed out that aircraft philosophy would look at the problem in terms of function: the frame and body must be a structural unit in operation, if not in fabrication. Aircraft objectives . . . making the best use of all structural material at hand, and making the structure direct and continuous . . . might well be applied to this decision of overall design.

Strength and weight ratio is at its best, they said, when each structural part carries its maximum load, discontinuity is avoided, and no low stress intensities allowed.

Pointing out that a favorable strength-weight ratio develops when functions of structure and shape are performed by the same material, they predicted a trend of this sort in passenger car bodies, but suggested that continued application of standardized bodies to various chassis may retard the process.

Although the low power required to overcome air drag at normal automobile speeds makes streamlining of small importance as compared with the need in aircraft, they suggested possible stylistic justification for reducing drag. The desirability of underbody streamlining, they said, can be determined only by wind tunnel and other tests. There is a possibility that any gains in reduced drag might be offset by resulting unruliness of the vehicle.

Weighing the possible gains of using an aircraft approach to the most important aspects of automobile design, and remembering that comfort apparently must predominate over structural efficiency in automobile design, the authors concluded that the better level for borrowing would be in the realm of secondary design considerations. Reasonable improvements would include

- Use of light metals where economically feasible.
- Flush windows and windshields to reduce drag.
- Reduction of turbulent flow through elimination of abrupt changes in sections, and reentrant angles.
- Better intersections of side posts with windshield, and of windshield V with brow of body.

What Motor Cars Could Be — WILLIAM B. STOUT, Consolidated Vultee Aircraft Corp.

GREATER luxury, more traction, extra room, easier driving, better vision, and improved control, are definite possibilities in the new type of motor car approach advocated by Mr. Stout.

By 1947, he said, the passenger car industry can have a Ford-Chevrolet-Plymouth-sized car with an oversized Cadillac interior, superior heat and sound insulation, and half the weight and twice the economy of the present standard car. It will do away with corner blind-spots in windshields, provide for easier servicing, and require less equipment at production and service points.

Superiority of these future models, he pointed out, will be based in part on higher speed, smoother running, more easily serviced engines, simplified instruments, and the use of new strong, light materials – probably not aluminum or plastics, but glass and fibre materials . . . in part on an enlightened conception of what the motor car can and should be able to provide in the way of service, comfort and performance.

In addition to general provisions for riding and driving comfort, he said, there are infinite possibilities extending as far as the combination trailer and motor car.

Mr. Stout described the experimental Scarab car, which he and others have driven on test trips for eight years, as an example of what can be done without special engine design, weight adjustment or weight location changes. Although these limitations result in a high center of gravity at the rear, and leave no luggage space except inside the car, the ride, he said, is "a revelation."

On the Scarab, a Ford V-8 crankcase is mounted over a Ford differential housing. Over this are the engine, flywheel and clutch, and a silent chain drive runs down to the jack line below and back to the gear box and the differential housing of the engine. There is

a universal joint on either side of the differential housing, and a swing axle running out to the wheels which toes in and out as the car bounces over bumps.

The complete engine installation, radiator, water and so on included, weighs 670 lb, weight which is directly over the rear axle. Between this and the body is a soundproof wall, to eliminate sound and heat, forming the back of the passenger seat at the rear of the interior.

Even lacking the advantages which would accrue from ground-up designing, Mr. Stout said, this model gives an unbelievably smooth ride, contains an interior area of 5 ft 8 in. x 10 ft, clear except for the rear seat, and has infinite possibilities for improvements in comfort, style and driving ease.

While the rear engine principle has not found enthusiastic reception by automobile companies, Mr. Stout emphasized the wealth of experience and the encouraging concrete results which have emerged from experiments in the past few years.

He believes that before long sales records will prove the value of the many advantages offered by rear engine mounting.

DISCUSSION

In answer to Mr. Short's remarks about streamlining, Mr. Stout pointed out that air never hits the automobile from the same direction twice; his experience has been that there is three to five times more lift from wind on a streamlined car than on a conventional car. Decreased drag is not important to automobile design, he said; increased controllability has much greater significance. His only recommendation for streamlining is flush windows . . . to eliminate noise.

In answer to a question by H. M. Martin, General Electric Co., Mr. Stout reported that the Scarab has a unit body.

Mr. Stout described the Scarab's suspension system, in answer to a question by Lt.-Col. J. T. Bugbee, Maintenance Division, Army Service Forces, as consisting of air springs like small tires, 10 in. in diameter, light in weight in proportion to their capacity, and with good shock-absorbing ability. There is, however, he said, no place to put them in the present car.

James J. Cotter, Automobile Safety Association, suggested that the extreme front position of the driver in this type car supposedly would improve vision, increase safety.

This brought emphatic agreement from Mr. Stout, who pointed out that there must have been a good reason for eyes being placed in the front rather than the middle of the head. Answering the same question from the aircraft standpoint, Mr. Short cited the fact that transport pilots are seated within a few feet of the absolute front of the plane, and emphasized the importance of the resultant improved vision and confidence.

Remainder of the discussion period was devoted to a debate about where the responsibility lies for making the automobile a better, safer, more logical vehicle. Mr. Stout told Lee Oldfield, Laboratory Equipment Corp., that the customer is the only important element in industry, and that the producer must wait upon his wishes. The motor car, he said, will be changed when the public asks for it. In Mr. Oldfield's opinion, it is the responsibility of the industry to educate its customers.

According to Past-President Harry T. Woolson, Chrysler Corp., the automobile manufacturer cannot afford to take the gamble of introducing radical new designs unless there is sufficient public demand.

Past-President Arthur J. Scaife, Office of the Quartermaster General, pointed out that the public seldom demands anything about which it knows nothing; the design engineer does not ask the public exactly what it would like to have, but rather tries to find out from the customer just what the vehicle is to be used for, what characteristics it should have, and makes his design accordingly.

Harold Rosen, American Grease Stick Co., compared automobiles with aircraft in this respect, asking how aircraft manufacturers could easily move the wing from top to bottom, with the resulting loss of passenger vision, while automobile manufacturers cannot budge the engine.

Mr. Short replied that the problems faced by the automobile designer in this respect are much more difficult than those faced by the aircraft designer, since the aircraft owner is not the consumer, and the buyer of aircraft is able to write specific specifications. When it arrives, he believes, the individual airplane will place aircraft designers in somewhat the same boat.

Body Standards Report — E. C. DeSMET, Willys-Overland Motors, Inc.

IN approaching the problem of body standardization, Mr. DeSmet reported, the question immediately arises as to what *can* be standardized in a body.

At first glance, he said, it might seem that the fundamental likeness of human beings would indicate possibilities for standards in the fashion department. Actually, however, tastes and preferences differ widely, and the fact that automobile owners are also automobile users makes the task of the automobile designer more difficult than that of, for instance, the bus designer.

Progress would be completely blocked, he said, if all automobile users were willing to accept identical designs. Customer individualism is the basis of competition.

Body standardization so far, therefore, has been directed toward the establishment of sound and practical nomenclature, simplification, and standardization of accessory features.

In due time, and with the help and suggestions of other committees and of members, Mr DeSmet believes, the Body Standards Group will be able to make a showing equal to that of other standardization groups.

Education Project Report — W. E. LAY, University of Michigan

REHEARSING the growth of an activity which Chairman Fishleigh characterized as a project to put body engineering on a plane with other types of engineering, Prof. Lay pointed out that one of the principal advantages of Michigan's Body Designing Course is its availability to men already in industry, rather than to undergraduates. These men have some drafting experience, and after this course in design will be able to fill a large and important need in the automobile industry. They will do much, he feels, to help the industry "meet engineering probems already looming up on the horizon."

TRUCK & BUS SESSIONS

Chairmen

S. Johnson, Jr. — **H. A. Flogaus**

The truck and bus sessions were concentrated heavily on the future which lies a long way, as well as immediately ahead, in this important branch of automotive engineering. Specific analyses of what is coming in trucks, in motor coaches and in highways comprised one of the two sessions, while the other was concerned with the vital problem of methods of rating brakes for commercial vehicles.

Review of Brake Design and Methods of Rating Brakes for Commercial Automotive Vehicles — R. K. SUPER, Timken-Detroit Axle Co.

VARIOUS methods of rating brakes of commercial vehicles have not kept up with the parade of progress, and engineers were urged to coordinate their thinking on brake rating with view of

arriving at some method which would be adequate to solving the increasingly difficult problem of designing more effective brakes for trucks and buses.

Any method for determining the adequacy of brakes must consider the units from an energy converting hypothesis with factors introduced to allow for engine horsepower and type of operation, the author stated, after reviewing numerous approaches made in recent years.

The following methods of rating brakes were proposed:

1. Projected area of the liner should be used where pressure-area or vehicle load-area are employed as a basis of rating brakes.

2. The work factor basis for rating brakes conforms more closely to the theory of utilizing the brakes as energy converting units. The author believes that this rating method gives a better interpretation of various designs than other schemes now in use. It also emphasizes the value of additional rating capacity in the brake design.

3. Adequacy of the brakes for each axle should be determined on the basis of load on the axle at the ground.

Facts of mileage life and work capacity of brakes have not been easy to establish. Unfortunately, maximum lining area continues to be the index of high capacity and good mileage, as shown by current design. He pointed out that adding lining on a brake shoe to obtain greater area and capacity is not the answer. The lining still remaining at the time of brake re-lining is the real evidence of this error in reasoning, it was pointed out.

Greater and faster dissipation of heat actually increases lining life and brake efficiency. The author pointed out that by combining the exposed inside and outside surfaces, the total heat dissipating capacity of the brake drum can be doubled by removing one-third of the lining and exposing the brake surface. This is due to the high temperature of the inside surface, which need not be carried through the drum.

The author discussed the problem from the standpoint of the land vehicle, airplane, and stationary equipment, holding that the principles involved were applicable to each problem.

DISCUSSION

B. E. House, Bendix Products Division, pointed out that simply adding more lining does not always increase brake capacity. Sometimes, however, lining is added to promote interchangeability or conservation of pedal travel by reducing length of unsupported drum surface between the shoes. This results, he said, in a compromise between cost and performance, so that such a move must be carefully considered.

He suggested that short linings are satisfactory for power braking of heavy trucks and buses where brake diameters are large and linings wide, whereas long linings are suitable for mechanical brakes, such as those used on light trucks, since insufficient pedal reserve is given when a comparatively large proportion of the drum is unsupported by the linings.

Objecting to the projected area method of rating brakes as having little meaning, Mr. House added that neither the "gvw per sq in. of lining" method of rating nor the "lb brake applying force per sq in. of lining" method takes into consideration the speed of the vehicle. This factor is important, he said, because vehicle speeds today are quite high, and kinetic energy increases as the square of the speed. Rating can and should be made, he said, based on energy absorption per unit area of lining per unit of time.

Replying to Mr. House's comments, Mr. Super said that the purpose of using projected area is to prevent the use of more than 120 deg of lining . . . that over this point lining is useless and expensive. Drum distortion is responsible for wearing the ends off lining, and wear at this point gives the illusion that lining ends are doing useful work, while actually they are not.

F. M. Ambler, Mack Mfg. Co., agreed with this limitation on arc length of brake linings, pointing out that long arc linings tend to reduce the service life between adjustments, since much of the available travel of the brake cylinder or chamber is required to close the clearance gap.

He brought up the problem of the proper amount of retarding force correctly distributed, which he considers a necessary adjunct of suitable lining area, although, he said, difference of opinion among automotive engineers as to the importance of weight transfer makes agreement difficult on this aspect of brake rating.

In reply, Mr. Super expressed the opinion that there was not enough weight on the front end of combination units to do much effective braking, so that he believed weight transfer should not be involved in the consideration.

H. H. Allen, Bureau of Safety, ICC, feels that weight transfer is an important factor in braking, and said that according to his calculation, the transfer was on the order of 40%. Under some conditions, he said, more braking is done on the front brakes than on the rear.

Sydney Tilden, Tilden Brake Service, offered the opinion that too little attention is given to the possibility of dissipating heat through the lining, shoes, and backing plate. Commenting on the previous question, he pointed out that weight transfer is a function of deceleration, and as such has importance only for emergency stops.

Hoy Stevens, American Trucking Associations, Inc., and Julius Gaussion, Silver Eagle Co., agreed that front axle load should be considered less than static load; Fred Lautzenhiser, International Harvester Co., Inc., emphasized the importance of measuring continued performance, or life factor.

J. George Oetzel, Warner Electric Brake Mfg. Co., pointed out the importance of heat performance in brakes, adding that unit lining pressure is no measure of this quality. A good index for heat ability is the ratio of torque to swept area, he said.

Wear, he said, seems to bear a relation to surface temperature. As liner arc length is reduced, the unit rate of heat generation is increased, and the critical temperature, at which the lining surface begins to disintegrate, is reached at about 86 deg of arc length.

The Motor Coach of the Future – L. H. SMITH, General American Aerocoach Co.

DELVING into statistics and known facts of passenger psychology, Mr. Smith emerged with a description of an ideal and not unfeasible motor coach for the future.

Rehearsing motor coach developments since 1925, when the 25-passenger intercity bus was introduced, Mr. Smith showed by graphs that the average intercity fare per mile fell from 3.22¢ in 1925 to 1.65¢ in 1944; the operating cost per mile in the same period rose from 15.09¢ to 28.4¢; and the seating capacity increased from 21 to 34. At present, he said, 17 passengers, or 50% capacity, will pay operating costs, while five, or 22%, sufficed in 1925.

Admitting that a future motorcoach based on a projection of these curves actually would present no difficulties of design or construction, he pointed out, however, that a prediction derived strictly from past trends would involve an overlarge and somewhat impractical future model.

He believes, therefore, that a more realistic prophecy would result from thorough consideration of such factors as consumer demand for frequency of service, convenience of stops, safety, comfort, and so on, and competitive demands for speed and cheapness.

With these requirements in mind, Mr. Smith conceives of the future bus as a longer, wider vehicle, powered, if not by atomic power, by a gas turbine connected with a small, high speed, glass insulated, D.C. generator, and four small, high speed electric motors; it will run at high speed over new super highways, will have power steering, minimum controls, and all conceivable accessories requisite to comfort, safety and ease of operation, maintenance and repair.

With these and numerous other advantages to recommend it, Mr. Smith believes, the postwar motor coach will be a vehicle admirably

equipped to compete with other forms of transportation, and to give the passenger really excellent service . . . perhaps at 1½¢ per passenger mile.

Motor Trucks of the Future – ROBERT CASS, White Motor Co.

WHAT happens to future motor trucks will be of vital importance to a great many people, according to Mr. Cass. Not only will it affect the six million men employed in manufacturing, maintenance, and operation of trucks, and the people who invest one billion dollars each year in new vehicles, but it will have its influence on other industries which must take distribution costs into consideration, and on consumers who pay these costs.

There is a great deal of room for improvement, he said, both along already established lines, and in the direction of specialized models for specific purposes.

Individual possible improvements actually except no aspect of the truck from powerplant to driver comfort. Whether or not the gas turbine will have a place in future trucks depends, he believes, on how it stands up against the future reciprocating engine in the five main considerations of size, thermal efficiency, maintenance, weight, and initial cost.

Some of the fundamental difficulties involved in application of the gas turbine he said, lie in inadequate development of such necessary features as bearings and transmissions.

An automatic transmission to meet the specialized requirements of bus operation, Mr. Cass feels, should function quickly and accurately, and depend not on speed but on power requirements.

Suspensions, steering gears, tires, and braking, he said, are of the greatest importance to a vehicle which should be safe to operate at speeds of 70 and 80 mph. Fatigue reducing features, such as comfort, clear vision, air conditioning, and better instruments, are all necessary and possible means of making the driver's work easier.

Qualities of corrosion resistance, insulation, non-inflammability, and shock absorption, Mr. Cass pointed out, are well within the limits of the plastic field, and will probably have great significance to future trucks.

Highways of the Future – HERBERT S. FAIRBANK, Public Roads Administration, Federal Works Agency

STRICT correlation between traffic needs and highway provisions is the only answer to the problem facing highway designers, Mr. Fairbank pointed out.

A far-sighted approach to the problem, he said, will have *function* as its main criterion. Careful investigation of the origin of the volume of traffic, its destination, and the most efficient means of carrying it there, is necessary before any coordinate planning can be done.

Highway systems should be contemplated as related wholes, he said, not as independent units. Thus an enlightened highway planning commission must recognize at the start that rural roads which perform an important feeder function can be as vital as main city streets; that bypassing of cities solves no problem, since most ultimate destinations lie within cities; and that geographical and political divisions must not be allowed to interfere with a long-view plan.

Although in the past many roads have been included in Federal-aid and state highway systems which might by definition have been omitted, and many which are vital have been left out, Mr. Fairbank believes that the provisions and the spirit of the Federal Aid Highway Act of 1944, combined with research and fact gathering by the highway planning surveys and the work and influence of the American Association of State Highway Officials and the Public Roads Administration, will lead to the ultimate matching of design and capacity with character, purposes and volume of usage.

Specific improvements Mr. Fairbank foresees as corollaries of this general integration and coordination are based on the report of the National Interregional Highway Committees, which he believes will be beneficially effective. These include controlled access to highways; wide firm shoulders; adequate sight distance at all points; adjustment of the number of lanes to traffic volume, and a minimum of signs and stop-and-go signals.

DISCUSSION

G. W. Laurie, Atlantic Refining Co., took exception to Mr. Fairbank's 18,000-lb limit on axle load. Pointing out that ordinarily road development has of necessity and automatically kept pace with vehicle developments, he suggested that a more logical plan than running a road system limited in this way across the country would be to build roads in heavily traveled areas to carry more weight.

Mr. Fairbank replied that primarily the purpose of highway systems is to aid efficient and economical transportation. There must be some connection between the economics of vehicle operation and the economics of highway provisions. Thus, he said, there is a general, total economics of highway transportation which should be sought out and followed by any plan. Before axle loads over 18,000 lb are sanctioned, he said, the question must be answered, "Will such an increase in load realize savings in vehicle operating costs which exceed the cost of building superior roads?" If the answer is yes, he admitted, this limiting figure should be raised.

Mr. Fairbank feels that actually this figure is not a limit on the carrying capacity, since increased payload can be realized through longer vehicles with more axles. He explained that the present limit has been established to conform with the load-carrying ability of a highway *system*, not of a few roads. This is necessary, he said, because there is no way to keep heavier vehicles, once they are designed and in use, from straying onto roads which are not designed to support their load.

H. M. Martin, General Electric Co., asked about immediate possibilities for widening narrow roads and laying center safety strips, as a safety measure until large-scale highway development work gets under way.

Mr. Fairbank replied that the 12-ft lane will be standard, that approximately 50% of the principal highways need widening, and that highway officials are agreed on the desirability of widening existing roads wherever possible.

Mr. Smith warned that development of intercity buses cannot be retarded to keep axle load under 18,000 lb, but he sees no necessity for this restriction since these buses will run only on large intercity "super" highways. In addition, he said, the 4500-lb rear tire which an 18,000-lb axle load would require and justify will not satisfy bus designers. At the present time, he said, a 7000-lb tire is in process . . . a tire which will not only support a much greater load, but which requires a greater payload to be economically feasible.

Mr. Fairbank admitted that this question is the outstanding issue between highway and vehicle designers, assigning the disagreement to governing economic factors in both fields. Although highway engineers are in complete agreement as to the necessity for this restriction, he said, there is a need for discussion between the two groups and clarification of general aims.

MATERIALS SESSIONS

Chairmen

W. H. Graves — **W. M. Phillips**

The aftermath of war was reflected in several of the materials papers, with warborn synthetics getting important attention and the war-made tin shortage coming in for analysis as well. Even the paper on methods for specifying materials clued back to war problems in some respects.

All of the papers, however, were directed definitely toward the future and toward the solution of postwar materials problems.

Substitutes for Tin in the Manufacture of Automobiles – C. E. HEUSSNER and E. T. JOHNSON, Chrysler Corp.

(Presented by Mr. Johnson)

THE scarcity of tin that was precipitated by the war will continue for some time to come, according to the authors. Not only is tin one of the rarest of the base metals, they point out, but the depletion of the geologic accumulations of this metal has been proceeding continuously since the beginning of the Bronze Age.

The current total stock of tin in the United States reflects this worldwide shortage thoroughly, for it is estimated that it is somewhat more than one year's usage at the present restricted rate.

It appears, therefore, that the development of substitutes for tin in the manufacture of automobiles will be of lasting benefit.

The authors report that the greatest savings of tin have been made by the following steps:

1. Redesigning parts to eliminate entirely the use of tin.
2. Improvement of processing to require the least amount of tin, particularly where ease of application is a major factor in using more than the minimum of tin, to attain required performances.
3. Development of alternate materials, preferably ones that can be domestically produced, to be used with current design and processing.

By these three methods, the authors claim, tin consumption per automobile was cut from over 4 lb in 1940 to 2 lb or less in 1945. While, in some cases, they said, such a policy may call for painful cost decisions, this is expected to be the exception rather than the rule. In fact, they report that their experience indicates that in many instances an actual cost benefit or increase in quality of product can be attained.

DISCUSSION

J. L. McCloud, Ford Motor Co., asked what success the tin can collecting drives had attained, and whether the tin thus obtained had materially contributed in meeting our tin shortage.

Mr. Heussner answered that the tin acquired through these campaigns had, in the early stages of the war, contributed somewhat in meeting tin needs for secondary applications; however, the change in the process to the electrolytic method of coating, whereby a very thin coat of tin was used, substantially reduced the ultimate value to be obtained from scrap tin drives.

Francis R. Moore, General Motors Corp., questioned whether any patent problem would be encountered in using brass-coated pistons as substitutes for tin.

Mr. Heussner replied that in so far as he knew such substitutes were entirely in order during the war; however, the question of whether they could be applied to competitive commercial uses should be determined by patent experts.

Various possible beryllium substitutes for tin were outlined by W. E. Martin, National Smelting Co. He stated that usually these substitutes increase the product cost.

Methods of Specifying Materials – J. L. McCLOUD, Ford Motor Co.

SPECIFICATIONS are available, Mr. McCloud showed, so that a materials engineer can express his choice effectively. The choice should be expressed understandably, he stressed, and should be used by the purchasing agent, the manufacturer and the receiving inspection to the ultimate end that the design conceived with the materials engineer actually is produced.

Noting and describing the various types of specifications available for use by the materials engineer, Mr. McCloud mentioned SAE specifications prominently as well as those of the American Society for Testing Materials, the American Standards Association, the Federal Government, and others.

He characterized the SAE Handbook as "a thoroughly human document, probably of more value than if it were really a scientific piece of work."

In addition to detailing the specific steps by which the materials engineer may do his job of specifying, partly in cooperation with other engineers and agencies, Mr. McCloud laid down the fundamental qualification needed by a materials engineer as that of having worked at his trade successfully for a long time.

Elaborating this theme, Mr. McCloud said that the successful materials engineer must have a fertile imagination and the faculty of seeing similarities, noting analogies and detecting differences between situations that now arise and situations previously encountered. "All the specifications ever written," he summarized, "can be only the type which the engineer selects to express the result arrived at by use of his own judgment."

DISCUSSION

E. L. Hollady, Ordnance Department, U. S. Army, stated that the Ordnance Department is attempting, wherever possible, to write specifications which give prime consideration to "end use" of materials, leaving the composition requirements as much as possible to the producer. He asked Mr. McCloud's reaction to such a program.

Mr. McCloud stated that this type of specification had been prepared very successfully by Technical Committee A on rubber compounds. He added, however, that there are instances in which the nature of material or the application makes it necessary to give composition requirements, and in such cases performance requirements alone will not suffice. The Germans and the British used performance specifications for steel, he said, but it is doubtful if American automotive manufacturers would be willing to give such freedom as to material composition to suppliers.

J. D. Redding, of the SAE Staff, was asked to outline the future plans of the Aeronautical Materials and Processes Committees. Mr. Redding reported that J. B. Johnson, chairman of the Aeronautical Materials and Processes Coordinating Committee, had recently surveyed the industry to determine whether the program should be continued, and replies received indicate very strongly that it should, although at a somewhat slower pace than during the war. He added that some 5000 individuals and companies are now receiving AMS specifications as they are issued, and that over 3,000,000 have been distributed to the industry to date.

Rubber! Where Do We Stand? Where Are We Going? – JOHN L. COLLYER, B. F. Goodrich Co.

RUBBER'S stake in the postwar world is one with unlimited possibilities, Mr. Collyer declared. The wealth of knowledge and experience fostered by critical wartime necessity, and the diversity of potential rubber uses, he said, make it one of the most important of postwar materials, not only to the automotive industries, which consume approximately 70% of total rubber in this country, but to the whole world.

The synthetic rubber industry was one of the noteworthy accomplishments of the war, but at the same time it has, with its million tons a year, created problems which will become a very definite challenge to the entire rubber industry as soon as natural rubber facilities are again geared for normal production.

In any consideration of a world rubber policy, Mr. Collyer said, there are a number of vital axioms which must determine the basic formula:

- United States military security demands a dependable source of rubber.
- Synthetic rubber has taken away natural rubber's claim to indispensability.
- Synthetic rubber has definite advantages in some uses, and the possibilities have not yet been exhausted.
- There are $700,000,000 worth of synthetic rubber plants in this country to be dealt with.
- The cost gap between natural and synthetic rubber, comparing costs in terms of finished product performance, has steadily narrowed.
- The effect of continued synthetic production on the economies of natural rubber producing areas, and countries which have invested heavily in plantations, cannot be ignored.
- Uncertainties must be taken into consideration – how long it may take for natural rubber production to return to former levels . . . when or to what extent synthetic rubber will improve in quality or fall in price . . . what America's policy will be regarding military and naval strength . . . other nations' policies in solving the postwar rubber problem.

• Even estimating world requirements optimistically, there will be a surplus of productive capacity of rubber.

Elaborating on this last point, Mr. Collyer said that the potential productive capacity of the world for natural rubber, after problems of equipment and manpower are solved, will be approximately 1,600,000 tons a year; world capacity for producing synthetic rubber is about 1,400,000 tons, one million of which are produceable in the United States.

Time for planning, he pointed out, is given by the necessarily slow acceleration of natural rubber production.

In his opinion, there are three basic considerations implicit in any rubber policy program.

1. A rubber famine would be disastrous to all peaceful countries. For this reason, a minimum production of synthetic rubber should be maintained if only to preserve know-how and encourage improvement, and there should be an emergency stockpile.

2. Policy calls for the best possible rubber products for consumers, at the lowest economical price, and the free play of competition.

3. The approach of the surplus problem must be kept in mind and constructively attacked.

If military security is provided for, if efforts are made to provide optimum consumer value, and if the uses of rubber are multiplied as they can be, he believes that the volume of rubber consumption can be substantially increased, prices lowered, and through this, standards of living in many parts of the world can be considerably improved.

The best activating agent for the accomplishment of these aims, he said, is competition – unhampered by tariffs, restrictions or cartels, and providing the best incentive for improvement and price reduction of both natural and synthetic rubber.

DISCUSSION

Chairman Phillips asked what would be the most apt use for the 300,000 tons of natural rubber on hand. Mr. Collyer replied that the passenger-car tire industry requires more than 300,000 tons annually. Synthetic rubber is better adapted to passenger car tires, he pointed out, because less heat is generated than in truck tires. He then went on to suggest that rubber may develop along the lines traced by metals – several varieties for different uses. Tires present a wide field for such progress, he said, since different parts of the tire demand different degrees of elasticity and other properties.

New Synthetic Lubricants **– J. C. KRATZER, Linde Air Products Co., D. H. GREEN, National Carbon Co., Inc., and D. B. WILLIAMS, Carbide & Carbon Chemicals Corp.**

(Presented by Mr. Williams)

IMPORTANT basic data on the performance of synthetic lubricants have emerged from their wartime use, the authors stated. Army Ordnance Department and Air Forces experiences have supplemented laboratory and field tests to provide information of great importance to their present use and future development.

Continuous effort has been devoted to the perfection of such synthetic lubricants as the LB and 50-HB series since the early 1930's, they said, and these lubricants have now been developed to a point where, although more expensive to produce than high grade petroleum lubricants, they exhibit characteristics which make them superior for some applications.

The LB series, consisting of lubricants which are insoluble in water, has high viscosity index, low API gravity, stable pour point, good flash and fire points, and low carbon residue values, and does not form insoluble oxidation products.

Extensive testing of LB-300 has shown, in addition to these qualities, ability to clean an engine in operation of oxidation products formed from petroleum oils, and to hold in solution about 3% of water at room temperature. However, there are no protective polar compounds formed as in petroleum oils, so that there is more danger of humid corrosion of iron and its alloys.

LB-550, used extensively in aircraft engines by the Army Air Forces and the Air Transport Command, the authors said, has exhibited such advantageous characteristics as low temperature starting, freedom from sludge and varnish, no congealing of oil in the oil cooler tubes, and easier cleaning; there was, however, accumulation of undesirable lead compounds from the fuel, greater leakage, and engine roughness from exhaust valve sticking after 400-500 hr of engine operation.

The water-soluble 50-HB series, they said, has proved to be an excellent lubricant for rubber, and also for many uses on metal.

It is believed that studies now being carried on will uncover other fields in which these new synthetic lubricants with their special properties will be particularly applicable.

DISCUSSION

In reply to a question by R. W. Goodale, Standard Oil Co. of Calif., concerning the use of detergents, Mr. Williams replied that neither the LB series nor the 50-HB series contains any detergent . . . that only anti-oxidants are used.

TRANSPORTATION & MAINTENANCE SESSIONS

Chairmen

E. P. Gohn — **E. N. Hatch**

Two symposium discussions were featured at the transportation and maintenance sessions, one on how chemistry simplifies automotive cleaning procedures and the other on various methods of determining when a vehicle should be retired.

Both topics, particularly the latter, brought out a variety of viewpoints and considerable fresh information.

How Chemistry Simplifies Automotive Cleaning Methods and Procedures **– RAY SANDERS, Turco Products, Inc.**

TIME and labor are saved, and excellent results achieved by the application of chemistry to problems of automotive cleaning, Mr. Sanders declared. Research and the accumulation of experience by the chemical industries, he said, are doing wonders in improving and simplifying methods and procedures.

Pointing out that no part of an automotive vehicle, interior or exterior, is exempt from the harmful effects of chemical or physical attack (clogging by iron rust, hard water scale and grease, deterioration, fire hazard, and other evils), he emphasized the essential need for careful, thorough, well-planned cleaning.

Formulation of cleaning compounds, he said, depends on such important basic factors as wetting action, emulsifying action, saponifying value, colloidal activity, solvent action and water conditioning.

Properties of chemical compounds, therefore, are developed to react in one or more of these ways for various applications.

Wetting action brings the cleaning solution into contact with dirt to be removed, and is accomplished by reduction of the surface and interfacial tension of the fluids; emulsifying action detaches oily globules from the surface and disperses them through the cleaning solution; saponification unites fatty acids in animal and vegetable oils chemically with certain alkaline substances to form soap; by colloidal activity solid particles are dispersed directly, and resinous binders are softened and swelled; and solvents either split up the dissolved substance into ions having definite electrical charges, in which case they act on salts, acids and alkalis, or do not produce such an effect, in which case they are effective on oils and greases, resins and other substances.

Consideration of total *effective* acidity or alkalinity is important in determining the value of a detergent, Mr. Sanders said; provision also must be made for control of water hardness.

Cooling system cleaning and maintenance, he said, is accomplished by procedures which utilize a combination of mechanical means to dislodge trapped solids and sludge, and chemical cleaning to remove grease, oil, rust, scale and corrosion.

Other parts are cleaned by varied methods involving spraying, immersion, vapor cleaning, and other processes.

Research and experience, Mr. Sanders pointed out, are essential for the proper use and adjustment of all these factors. With adequate knowledge, he said, the forces and properties possessed by various chemical agents can be applied in scores of valuable ways.

DISCUSSION

Hoy Stevens, American Trucking Associations, Inc., pointed out that many difficulties which develop in engine cooling systems after long use have still not been clearly

analyzed. Questioning the value of merely boiling a radiator in a tank, he expressed the belief that circulation of the hot alkali cleaner through the radiator is the only complete method of interior cleaning. Particles of water pump packing often found in water pump bearings, which are not reduced by the alkali cleaner, he said, can best be removed by rodding the tubes with a small rod, then inverting the radiator to flush out the dislodged material through the filler spout.

Actually, he maintained, there is no need for grease in the cooling system, so that a partial answer to the cooling system cleaning problem is to utilize pump designs which eliminate grease lubrication.

Hard-water scale is a contributing cause of valve cracks in engines newly rebuilt, he said, since fringes of scale and rust tend to curl and crack off when water jacket surfaces dry out during overhaul. Removal of hard-water scale and rust formation during overhaul, and at periodic intervals, has been proved good policy. A strong, plentiful acid mixture is required, he added, to do the job well.

Mr. Stevens suggested a cessation of the fill-and-overflow methods of testing water level in engine cooling systems, to avoid loss and dilution of treated solution. Chromate materials, which are effective in stopping electrolytic corrosion between most metals used in engine cooling systems, can be tested for effectiveness by sampling with a phenolphthalein indicator. Testing in this way at regular preventive maintenance inspections may show up overheating with loss of water, leaks, or excessive overfilling.

Asked by Warren Taussig, Burlington Transportation Co., whether he favored cold or hot tanks for immersion cleaning, Mr. Sanders said that he considered both highly desirable, but that if he were limited to one method, he would choose cold tanks because of their safety for all metals. For cleaning aviation parts, he said, this characteristic of nonreaction on sensitive metals is especially valuable.

B. J. Lemon, U. S. Rubber Co., inquired about fields other than those strictly automotive in which new cleaning methods have been employed. Mr. Sanders answered that attempts were made to cover all cleaning problems which might arise in any field, and emphasized the value of transferring knowledge gained in one field of application to other fields. Tire molds, he said, have been successfully cleaned in cold tanks with the use of substances quite similar to recently developed paint removers.

In answer to a question by Howard L. Willett, Jr., Willett Co., about the factor of safety in the use of chemical cleaning solutions, Mr. Sanders stated that there is nothing injurious in any fluids used, but that in the use of stronger paint removers and similar substances, good ventilation is advisable.

Carl Hirdler, Turco Products, Inc., supplemented the information presented by Mr. Sanders, stating initially that research in the chemical cleaning field is devoted more to utilizing successfully those chemical factors already developed than to developing new ones.

Describing the processes of cold and hot tank cleaning, Mr. Hirdler said that in the hot tank method, the solvent action of the water employed is increased by building up its saponification and emulsification value in order to get behind the soil and contamination. Petroleum, not being saponifiable, has to be emulsified, so that each globule is sealed in an envelope of water.

The cold tank, on the other hand, uses little or no water. Emulsifying action is combined with solvent action so that oil, grease, and resinous binders are first dissolved, then emulsified for removal.

Soaps used in hot tank solutions, Mr. Hirdler pointed out, should be such that they will not completely dissolve at the temperature at which they are designed to be used. The water conditioning agent used should sequester, or tie up, the hardness-forming elements in the water, in the form of soluble material which will not precipitate out at all, so that it may be easily removed by rinse water.

One material, he said, should be designed to take care of several jobs at once, so that solutions will not have to be altered to take care of each new cleaning problem as it arises. In this way, several causes of engine failure can be knocked out simultaneously.

SYMPOSIUM
Approaches to Vehicle Retirement

– Petroleum Distributor, GAVIN W. LAURIE, Atlantic Refining Co.,

"IT has been our experience that, where a fleet of trucks is operated on a preventive maintenance basis, there is little justification for replacement of equipment other than obsolescence, changes in state weight regulation where the truck operates, and accident," declared Mr. Laurie.

Going on to elaborate on the obsolescence factor, Mr. Laurie said that changes in marketing and distribution policies, and labor policies of the operating company were practical manifestations of obsolescence which must be considered along with technical advances of the automotive and petroleum industries which might result in reduction of such major expense items as fuel.

As an example of the effect of regulation changes, Mr. Laurie said that in his fleet were a group of 39,000 lb g.v.w. units that had accumulated about 250,000 miles in two years. These trucks had operated under preventive maintenance and were in excellent operating condition. Nevertheless, these units were under consideration for retirement because the state in which they operate had liberalized its weight laws permitting 45,000 lb g.v.w. This increase, with attendant increase in payload capacity, definitely justifies replacement of the equipment with vehicles designed to carry the larger load.

In every formula for determining obsolescence that has come to Mr. Laurie's attention there have been one or more assumptions that would not stand up under practical criticism.

– Inter-city Buses, W. A. TAUSSIG, Burlington Transit Co.

BEGGING to be excused from presenting any engineered mathematical formula for the retirement and replacement of vehicles, Mr. Taussig indicated that the value of the sales appeal of a new vehicle to passengers was probably the most important single consideration. Obsolescence of luxury items, such as more comfortable seats and air conditioning, occurs with greater frequency than the point where a bus is no longer economical to operate.

Mr. Taussig finds that some of the older pieces of equipment with engines in front are actually cheaper to operate, but passengers do not like to ride in them. A chart shown indicated a trend which would have made the operating cost of vehicles put in service in 1936 lower in 1944 and 1945 than they were in 1943.

The questions in order of their importance which must be answered before any determination to retire a bus can be made are:

1. What is your competitor doing?
2. How many additional passengers will be induced to ride your line as a result of new equipment?
3. What fuel savings, if any, will be secured through the use of new equipment?
4. How will maintenance and other operating expenses of the new equipment compare with that of the old equipment?
5. What will be the effect on the morale of your entire organization as a result of the new equipment?

– For Hire Carrier, H. L. WILLETT, JR., Willett Co.

CONSIDERING each vehicle as a separate problem, a committee headed by the treasurer and composed of a representative of the Operating Department and a representative of the Maintenance Department decides upon retirement and replacement in Mr. Willett's fleet.

The Operating Department analyzes the work the vehicle is to do and estimates the mileage at fixed periods and sets forth the condition under which the vehicle will operate. The Maintenance Department estimates the length of time or number of miles that the vehicle will operate at a fixed low maintenance cost. The depreciation rate is set to write the vehicle off the books before the high maintenance sets in and the vehicle is normally retired when fully depreciated.

As examples of this policy, Mr. Willett listed the folowing:

a. "Depreciate two panel trucks at 80,000 miles; one in 3½ years and one in 5 years. One at $3.46 per week and one at $4.54."

b. "On our milk truck we throw the mileage factor out the window and simply say 6½ years is the depreciation time. This shows $2.84 per week."

c. "On another vehicle we use 250,000 miles as contrasted with 80,000 miles and we do not use a mileage factor on the trailer. This shows $39.39 per week."

– Public Utility, D. K. WILSON, New York Power & Light Corp.

(Paper presented by J. Y. Ray, Virginia Power & Electric Co.)

SINCE the art and science of engineering as applied to vehicle maintenance is entirely too much art and not enough science and there are no accepted wear standards which determine when a vehicle is worn out, the replacement of vehicles problem defies any formula solution, according to Mr. Wilson.

Listing the factors that affect replacement and retirement, Mr. Wilson named six considerations that vary from fleet to fleet and from time to time. They are:

1. Depreciation policy.
2. Operating conditions.
3. Maintenance policy.
4. Concentration of fleet geographically.
5. Market conditions for new and used vehicles.
6. Mechanical condition of vehicle.

The public utility industry has been slower to replace vehicles than many others because, except for motor vehicles, office furniture, and lightning arresters, the industry has become accustomed to long-lived equipment.

At present most retirement policies are based on depreciation rates determined by past experience, subject to annual revision. The actual retirement is decided by a comparison between the book value of the vehicle and the repair costs for the vehicle. This seems to be as good a way as any at present, but a retirement policy should include an attempt to predict the future, which is desirable but difficult.

DISCUSSION

Mr. Ray indicated that depreciation had little relation to retirement since in the case of a public utility the method of accounting was determined by the public utility commission.

Some of Mr. Ray's trucks were in effect traveling tool houses that traveled very few miles per year, could hardly become obsolete so long as they would run. Cost per mile is a matter of very little moment in this case. Practically, Mr. Ray has found that his replacement rate in normal times has been half-ton trucks every three to four years and the heavier units at about 10 years.

Depreciation is an accountant's problem and in large organizations the fleet operator usually has to go along with company policy, according to Fred Faulkner, Armour and Co. Mr. Faulkner stated that he preferred the residual basis of depreciation rather than the straight-line basis and with it the increasing cost of maintenance and lowering depreciation balanced, with the effect that cost per mile of operation stayed fairly consistent throughout the life of the vehicle. Obsolescence is a bigger factor in replacement than the wear out factor.

Mr. Laurie did not find that new equipment improved morale as stated by Mr. Taussig because employees preferred the vehicles they were used to and had worked with for long periods. In reply, Mr. Taussig said that he thought his statement applied only to employees of companies engaged in selling transportation.

S. G. Page, Equitable Auto Co., indicated that wear tolerances were of little value on light trucks because by the time replaceable items were worn out, upholstery, body, and other parts that were difficult to repair were in bad condition.

Entering a short-term retirement plan cost his organization about a quarter of a million dollars, E. W. Templin, Los Angeles Department of Water and Power, reported. Normal retirement was interrupted by the war, he said, just as the plan was well started.

AERONAUTIC SESSIONS

Chairmen

E. A. Ryder — **C. F. Taylor**
G. A. Gilbert — **Charles Froesch**
Peter Altman — **Dr. F. W. Ross**

Dealing with powerplants, transport, and airplane technical problems, the aeronautical sessions covered a wide range of topics and procedures.

Foreign as well as domestic engineering elements were explored and analyzed, gas turbines and jet-propulsion questions were extensively discussed, and all-weather flying techniques were given particular attention.

***Design of German Aircraft Hydraulic Systems and Their Components* – R. H. DAVIES, Parker Appliance Co.**

(Paper presented by Dr. Louis Marick, U. S. Rubber Co.)

OUTSTANDING features and designs of German aircraft hydraulic systems and their components which appear to be unique in construction or new in design and which may have application to developments in the United States were reported by Mr. Davies. He discussed German practices and policies with regard to hydraulic design and manufacture as well as the basic design features of German hydraulic systems and various individual items of equipment used in these systems.

Mr. Davies stated that whereas United States tendencies seem to have been to overdesign, the Germany tendency was to underdesign, on the theory that if trouble developed, increases in strength and changes in the design could be made as found necessary. This was apparently found necessary in a surprising number of cases.

In Germany most hydraulic units were designed by the big hydraulic firms such as Electron, Elma, V.D.M. or Teves, to the specifications of the airplane manufacturers or the Air Ministry. Likewise, many of the hydraulic system requirements for a specific airplane design were obtained directly from the Air Ministry. He reported that many of the things which were considered poor design in the United States were practiced by the Germans with apparent impunity.

A great deal of standardization was practiced but was by company and not on an industry-wide basis. For example, valves for a given capacity manufactured by one company would be totally different dimensionally and internally from those manufactured by another company but they would meet the same performance requirements and would have the same size port connections as required for their standard line.

German designers and component manufacturers seemed agreed on open center systems or designs which were slight modifications of the open center system. They preferred these because of the elimination of accumulators and unloading valves, with the consequent weight saving, and elimination of other accompanying problems. This also avoided the necessity of having the system under pressure except when actually needed for operation.

Fifteen hundred psi was standard in most modern German designs. Some of the newer designs used 2250 psi but no airplane had yet been proposed with a 3000-psi system, although studies had

been made and data prepared on the weight savings to be realized by going to 3000- and 4500-psi systems.

Aluminum tubing and flared fittings were the tendency except in the engine compartment where steel tubing and brazed-on fittings were still used exclusively. Straight thread makeup fittings were used to the exclusion of all pipe thread connections. Tube fittings were all one type and had an external thread and inverted cone similar to our AN 800 series fittings.

Mr. Davies described the significant features of three German airplanes, namely the DO 335, ME 262 and the ME 410. In the DO 335 system no unloading valve is used in the circuit and no hand pump is provided for emergency operations. The brakes were shoe type and acknowledged to be inferior to our disc type brakes. All rudder pedals were standardized and the power brake control valve was assembled as a part of the pedals.

An unusual way of obtaining boost in the flight controls for high speed performance was by means of moving the fulcrum point of the control system leverage by means of a hydraulic cylinder.

Mr. Davies reviewed many features of individual items of equipment such as the double piston Teves hand pump and the use of tension spring in a relief valve for pulling a loosely guided poppet into its seat.

In conclusion, Mr. Davies recommended we give serious consideration to the use of the open center type of hydraulic system and simplicity of design as used by the Germans. He also reported that the ingenuity and originality of design shown in individual items of hydraulic components aimed at mass production should not be overlooked in this country.

DISCUSSION

Capt. H. J. Marx, Navy Bureau of Aeronautics, referred to the original report prepared by Mr. Davies on his return from Germany and stated that the Bureau is obtaining and translating copies of many of the original German reports obtained by Mr. Davies. They plan to reproduce the data and make them available to the industry. He referred to the original use of open center type of hydraulic systems in this country by the Army Air Forces and reported that there is an increased trend toward this type of system by both military services.

Major G. E. Davison, Aeronautical Board, commented on the German standardization work and felt that it paralleled ours in several instances, particularly in connection with the use of standard nuts, bolts, washers, and so forth, such as our AN utility parts standards.

He felt that although it was not indicated that the German hydraulic fittings were an Air Ministry standard, no doubt these items are standardized and are interchangeable.

He also called attention to the Argus detachable hose ends in Germany and the fact that they parallel the use of AN standard detachable hose ends in this country. The German Argus self-sealing coupling is also very similar to the AN standard self-sealing coupling. The experience of United States military services indicates that it is surprising that Germany did not attempt to standardize upon several of the most satisfactory designs of hydraulic packings as the stocking problem of our military services was considerably simplified by the use of standard "O" ring hydraulic systems. He reported that the Aeronautical Board plans, with the aid of the Army Air Forces, Bureau of Aeronautics, and industry committees, to maintain the present AN standards for hydraulic equipment up to date and to continue to issue new standards as the need requires. He felt that the system of industry-wide standardization followed in this country is considerably preferred over that apparently followed by the Germans.

Kemp Lasswell, AAF Air Technical Service Command, Wright Field, reported there is a decided swing to the use of open center hydraulic systems in this country and that they were first used on the Consolidated B-24. He endorsed the German use of gravity for landing gear operation and believes that this will be followed in the United States in the future. He also reported a strong trend toward the combination of hydraulic and electrical systems in the United States but felt that manual emergency operation of electrically controlled hydraulic valves is essential. He pointed out that the United States was far ahead of Germany in the use of high-pressure hydraulic systems with their resultant weight savings and other benefits.

He reported that Army Air Forces maintenance personnel believe that the standardization of the internal detail working parts of hydraulic equipment is preferable and necessary in order to reduce stocking problems. Germany also apparently failed to recognize the problems to be encountered in extreme low-temperature operations.

He reported that the United States has not been able to use either rubber or synthetic rubber "U" cups where it is necessary to pass them over supports and expressed the opinion that possibly this indicates that they had better packing compounds available.

B. R. Teree, Cornell Research Laboratories, called attention to the complexity of the German hydraulic system resulting from their attempts to develop many automatic operations and urged that greater effort should be placed upon simplicity of design and the avoidance of sequence valves and flow dividers wherever possible.

He also reported that the difficulties encountered in this country with hydraulic packings and fluids are now being studied by a Government-industry advisory committee.

W. H. DuBois, Bendix Products Division, Bendix Aviation Corp., reported that all of the German aircraft in this country which he has inspected have been very much underbraked and reported that they have used up to 14,000-18,000 ft-lb of energy per sq in. of braking surface installations and that they have tried to handle larger airplanes with a manual brake system incorporating a compound master cylinder than we would consider possible in this country. Mr. Lasswell felt that the underbraking was probably the result of the pressure of aircraft designers to obtain increased aerodynamic performance at the cost of decreased ground performance.

Heat Recovery as Applied to the Heating and Anti-Icing of Aircraft—JOHN J. DRANEY, Consolidated Vultee Aircraft Corp.

(Paper presented by Dr. Louis Marick, U. S. Rubber Co.)

HEATING and anti-icing of aircraft by means of recovered exhaust heat, Mr. Draney reported, have now passed through the experimental stage, so that from now on operators can be assured that aircraft incorporating these components can be procured that will operate in a satisfactory manner, thus increasing the usefulness of the airplane and making it practically an all-weather means of transport.

Mr. Draney stressed, however, that the heating and anti-icing system should be incorporated in the original preliminary design of the plane, as this procedure will give a cleaner system, leading to savings in weight and improved serviceability.

The present method of using recovered heat was described by the author as a two heat exchanger system. It consists of a primary heat exchanger (exhaust gas to air) in the powerplant and a secondary exchanger in the fuselage. Ram air passed over the air side is directed to the primary side of the secondary exchanger, where heat is transferred to a new source of fresh air, thus assuring that only clean air free from carbon monoxide is delivered to the cabin.

In designing an anti-icing system it has been found, Mr. Draney reported, that approximately 1500 Btu per hr per sq ft of protected area is required for airplanes in the 150-200 mph class, and proportionately more for airplanes of higher speed. This figure gives a temperature rise of 100 F above ambient dry air on the leading edge of the aerodynamic surfaces for approximately 10 to 15% of the cord, depending on the type of airfoil.

The latest development for supplying heat was also described by

Mr. Draney. This is a system of bleeding exhaust gases directly into a jet pump that mixes the high-temperature gases with either ram or static air in a proportion that will give a 300-320 F air-gas mixture at a pressure sufficient to overcome the pressure losses in the ducting system.

Mr. Draney discussed some of the problems that this system involves, such as corrosion due to products of combustion, carbon monoxide, moisture condensation in ducts and surfaces, after burning, design of a suitable jet pump, and design of suitable valves in the exhaust system. None of these problems appears to him, however, to offer too great difficulty, when approached in the proper manner.

DISCUSSION

E. E. Hayes, Pennsylvania Central Airlines, asked what effect, if any, this extreme heat produces upon the structure of the wings and other members.

Dr. Marick replied that to the best of his knowledge no detrimental effects resulted so long as the heat did not greatly exceed 250 F.

A. L. Roder, Stewart-Warner Corp., added that a recent NACA investigation considered this matter and conclusions could be obtained from the NACA.

J. F. Haines, General Motors Corp., reported that the NACA has measured efficiency losses of 2% to 3% associated with the tip vent needed for direct heat de-icing of hollow propeller blades. This represents, he said, a fuel weight of about 12 lb per hr per 1000 cruising hp, and occurs whether de-icing is being used or not. In addition, this method of de-icing is difficult mechanically, and not light.

The hub generator, Mr. Haines said, can be considerably reduced in weight as compared with the original designs tested to date. Use of slip rings to feed electrical energy to the propeller from the airplane's electrical system, he said, has some weight advantage, particularly in larger aircraft having sufficient electrical capacity for other purposes which can be drawn upon under icing conditions.

W. H. Hunter, NACA, remarked that the tip loss due to pumping can be reduced by more efficient utilization of heat by restricting the blade cavity to put the heat where it is needed.

B. H. Shinn, Firestone Aircraft Co., inquired into the possibility of de-icing by installing exhaust heater units in the propeller blades. Mr. Hunter answered that he feels such an installation would add prohibitive weight.

Richard Prewitt, Kellett Aircraft Co., asked if consideration had been given to the danger of weight increase due to soot accumulations inside the heating vents, and methods of cleaning these vents had been considered. It was pointed out that Mr. Kirchner's paper on "Report on the German Commercial Airline: Deutsche Lufthansa (see p. 62), indicated that the Germans had encountered sooting difficulties; however, no mention was made of difficulties due to weight increase as a result of soot accumulation.

Design Trends in Aircraft Exhaust Systems – **RALPH L. HAVER and HARRY A. GOODIN, JR., Ryan Aeronautical Co.**

(*Paper presented by O. E. Ross, Ryan Aeronautical Co.*)

THE plain fact is, the authors of this paper reported, that the materials now available for use in exhaust systems are not able to withstand in a satisfactory manner the high temperatures and corrosive atmospheres to which they are subjected. This problem is so serious, they explained, because it means higher cost of maintenance and operation and because it stands in the way of rapid increases in available thrust from our powerplants.

For instance, extreme increases in thrust can be obtained, they said, with our present jet engines by utilizing the reheat cycle. This operation, however, means using exhaust gas temperatures in the range of 3000 F or higher, whereas the best materials available today cannot be expected to operate successfully at metal temperatures above 1300 F.

This new material that needs to be developed must have, they observed, a scale point above that of exhaust gas temperatures, a comparable increase in tensile strength, along with considerably reduced carbon absorption rates if the absorption of carbon affects its strength and deterioration factor.

Considering the question of the exhaust collector versus the ejector or jet stack, the authors concluded that, in the future, aircraft using reciprocating engines will utilize the exhaust collector ring for transport aircraft because the jet stacks are noisy and produce a glare and flame disturbing to passengers at night. They will also be used on high-altitude aircraft with exhaust turbine installations and cargo aircraft. Military cargo aircraft, however, may utilize jet installations for increased performance. Jet stack installations will be mainly used on light military aircraft where exhaust turbines are not a requirement, as the use of jet stacks gives an increase in speed as compared with the use of exhaust collectors, a more important factor than comfort and service life in this class of plane.

DISCUSSION

John G. Lee, United Aircraft Corp., agreed with the statement in the paper to the effect that ejector stacks are undesirable due to excessive noise, but feels that this problem can be controlled and is being controlled by the use of ejector pumps.

G. W. Newton, Boeing Aircraft Co., asked if since inconel is becoming more readily available, there will be a preference for its use over stainless steel. Mr. Ross answered that to the best of his knowledge the qualities of inconel as compared with those of stainless steel are on about an even par. Therefore, he would expect the determining factor to be cost.

Another member of the audience said that he feels a better knowledge of stresses involved in exhaust system design is of fundamental importance, and should be given as much consideration as metallurgical problems.

Aircraft Powerplant

German Jumo 004 Engine – **CAPT. WARREN C. GERLER, Air Technical Service Command**

A REPORT on the Jumo 004 turbo jet engine, two of which powered the famous German jet-propelled intercepter airplane, the ME 262, which proved havoc to our bomber formations over Europe, was given by Capt. Gerler.

Preliminary work on this engine was started in 1937 by the Junkers Aircraft Corp. However, it was not until 1939 that the idea of jet propulsion was taken seriously.

After unsuccessful efforts with a scale model, due to inadequate performance of the scaled-down combustion system, he said, Junkers decided to construct a full-scale prototype engine. This unit, the author explained, was substantially the same as their latest production engines, having an eight-stage axial-flow compressor, six straight-through combustion chambers, and a single-stage turbine.

The 004A engine ran for the first time, the author reported, in the end of 1940, and the original flight test with this engine was made in a flying test bed (ME 110) late in 1942. As a result of these flight tests the 004B was designed, incorporating major modifications that resulted in greater thrust and reduced weight, Capt. Gerler stated. Flight tests of this unit proved so successful that production was at once put on top priority. The total number of 004B series engines produced, he reported, was about 5000.

One production model of the engine, the 004B1, has solid turbine blades and is rated at 1870 lb thrust, while the 004B2 has hollow turbine blades and is rated at 1980 lb thrust.

A high specific fuel consumption was given for this engine, approximately 1.4 lb fuel per lb thrust per hr.

Capt. Gerler described the engine in considerable detail, starting at the front inlet and carrying through to the exhaust.

Combustion efficiency calculated under static sea level rated conditions is about 90-92%, he reported, and the pressure loss is approximately 2.5 psi. Considerable burner blowout trouble was encountered with the combustion system. At 30,000 ft it was only possible to throttle back the engine 400 rpm or to 8300 rpm turbine speed in order to stay out of the nonaccelerating region and the burner blowout zone.

Although the combustion chambers had a normal life of only 25 hr, Capt. Gerler said that the combustion assembly was not accessible to replace flame tubes without a major disassembly of the engine.

In conclusion, Capt. Gerler pointed out that in spite of a shortage of high-temperature material and the poor performance of this engine, Junkers was the first manufacturer to have turbo jet engines in production and installed in a military fighter airplane.

DISCUSSION

W. J. Kings, Buda Co., asked if we had had much information on German jet propulsion work before the end of the war. Capt. Gerler replied that, although we did have a little information on what the Germans were doing before the war was over, it was not until after we were able to have complete engines sent over that we were able to study and test them completely.

In reply to a question about temperature spread within the combustion chamber, Capt. Gerler said that it was quite great, of the order of 250 F. He also mentioned that flow into the combustion chamber is about 290 fps while it is probably only about 100 fps in the combustion chamber itself.

Aircraft-Engine Induction System Deposits — W. J. SWEENEY, J. F. KUNC, JR., and W. E. MORRIS, Standard Oil Development Co.

(*Presented by Dr. Kunc*)

ALTHOUGH only a few isolated cases of excessive deposits in fuel induction systems of aircraft engines have been reported so far, the potential seriousness of the problem prompted the authors to investigate the nature of the deposits as well as the variables covering their formation and accumulation.

Basing their conclusions on field experiences and extensive laboratory tests, the authors reported that:

1. Any increase in nonvolatile constituents of fuel is favorable to deposit formation and should, therefore, be avoided.
2. The inhibitors used to stabilize fuels against deterioration in storage differ radically in their deposit-forming tendencies. Oxidized inhibitors are particularly bad.
3. For a given engine and fuel, there appears to be an induction system temperature that will give maximum deposit formation, or conversely, for a given operating temperature there appears to be a fuel volatility that gives maximum deposition. Over the ranges studied, deposit formation was greatest with relatively volatile fuels at high operating temperatures.
4. The addition of a solvent oil to fuel tends to prevent deposit formation.
5. The rare cases where sufficient quantities of deposits are formed in service to result in deterioration of engine performance are probably due to the coincidence of a number of conditions favorable to deposit formation.

It appears that the effect of these deposits is not always immediately noticeable. Only if wide-open throttle is normally used does the reduction in airflow caused by deposits cut down power; at part throttle, the operator would merely have to open the throttle more. When engines are equipped with gear-driven superchargers, the authors pointed out further, deposits building up on diffuser plate and impeller may even result in mechanical failure.

Holding fuels more rigidly to specification is not the answer, for the authors showed that fuels meeting all existing specifications contain more than enough nonvolatile material, even when not considering the tetraethyl lead, to cause operating difficulties, if conditions particularly conducive to deposit formations prevail.

DISCUSSION

It was the thought of Dr. C. D. Lowry, Jr., Universal Oil Products Co., that a distinction should be made between difficultly volatile material, such as inhibitors, which can be evaporated under some conditions, and practically nonvolatile material, such as gum and dye, which cannot be evaporated at all.

"We don't believe," Dr. Lowry continued, "that there is any proof that the course of oxidation of an inhibitor is the same when it is subjected to airblowing as when it protects motor fuel in storage. The relative deposition tendencies of inhibitors should be considered in relation to their relative effectiveness in preventing gum formation and lead deposition."

Both Chairman Ryder and A. L. Beall, Wright Aeronautical Corp., thought that deposition is more prevalent than the authors suggested. Mr. Beall reported that significantly large deposits on both impeller and diffuser have been noted on certain high-power output engines.

The vicious circle of adding inhibitors to gasoline to eliminate gum and lead precipitation in storage, and then having to add solvents to keep the inhibitors from causing trouble, led Mr. Beall to call for studies to be made to find other means than inhibitors to keep gum and lead precipitation in storage within limits. Alternately, he said, some means of keeping nonvolatiles, not useful in combustion, to a minimum may pay dividends beyond the expectation of the authors.

In reply to a suggestion that a small amount of gasoline be sprayed into the induction system to clean it, Dr. Kunc explained that the deposits tend to oxidize after they have been formed and cannot be removed by hydrocarbons. He said that alcohol, acetone, and chloroform are good solvents.

Factors Affecting the Design of Jet Turbines — WILLIAM R. HAWTHORNE, British Ministry of Aircraft Production

WHEREAS the design of piston engines has been mainly a matter of solving mechanical problems, Mr. Hawthorne explained that with the jet turbine, while mechanical problems are not to be ignored and stress problems are simpler, the major problems are rather of an aerodynamic nature.

The most important conflict in the design of the gas turbine, Mr. Hawthorne emphasized, is that between Mach number and stress. Research is needed, he said, in two main directions. In metallurgy there is much yet to be achieved in developing materials to withstand creep and fatigue, oxidation and erosion at ever higher stresses and temperatures. In aerodynamics, compressible flow is the greatest field of research. The control of gases moving at higher speeds must be perfected. The aerodynamics of the combustion process must be better understood and then the knowledge applied.

Because of the relative simplicity of rotating machinery and the continuous-flow process, however, Mr. Hawthorne reported, the performance of turbine engines can be predicted with greater confidence than has ever been possible with reciprocating engines. This simplicity, he continued, is enhanced by the functional separation of the components compression, combustion, and expansion occurring in different parts of the engine instead of all in a cylinder. Thus, it follows that each component may be put through a separate process of aerodynamic development on suitable test rigs. Then, using the results of such tests and his experience with aerodynamic problems, the designer may scheme different arrangements of the various components and assess their merits with fair confidence in his calculations. Consequently, while the gas turbine offers a challenge to the aerodynamic skill of the designer, its advent permits him to employ the powerful weapon of analytical calculations to an extent hitherto impracticable. Experience has already shown the value of the analytical approach in the design stage, in predicting possible troubles and in the interpretation of test results.

Using this analytical approach in the development of his paper, the author reviews the problems of designing a jet turbine with a centrifugal compressor, laying most emphasis on the aerodynamic and stress limitations.

DISCUSSION

In comments read by R. W. Young, Kenneth Campbell of Wright Aeronautical Corp., emphasized the difficulties in drawing too tight a conclusion from the study of a specific design. The fact that the author has restricted his paper to the predetermined design achievement of high power-weight ratio, Mr. Campbell said, has necessitated his foregoing some qualifying factors of great importance to the student of designs as a whole.

For instance, Mr. Campbell pointed out, from a strictly power-weight ratio standpoint, there can be no argument with the emphasis that the author has placed on the merits of the impeller having double inlet, running at a very high tip speed to attain the pressure ratio desired from a single stage; however, from an efficiency standpoint, Mr. Campbell wondered whether the author's figure of 75%, excellent for 1500 fps tip speed, is inclusive of the induction losses to the rear impeller.

Engineering Development of Jet Engine and Gas Turbine Burner – **FRANK C. MOCK, Bendix Products Division, Bendix Aviation Corp.**

MOST engineers, having taken care of bonfires and used Bunsen burners and blow torches, may think themselves experts in matters of combustion and consider that designing a jet burner would be easy, but take the word of Mr. Mock for it, it is anything but a simple matter. Maintaining stable combustion with air velocities of 80 mph in the burner is more difficult than it may seem.

In addition to the usual powerplant requirements of efficiency, complete combustion, proper temperature distribution, and minimum volume and weight, the internal-combustion turbine is subject to certain special requirements for aircraft operation. The author outlines these as follows:

1. It should start easily, positively, and consistently, without detriment to engine life; it should restart in the air without complex or difficult manipulation by the pilot.

2. The engine should fire without blowout or dieout at all speeds, altitudes, and throttle positions that the pilot can use in flying. All *A/F* regulation should be automatic, it should not be necessary for the pilot to nurse the throttles.

3. To avoid fire risk, ignition should be positively accomplished under any rate of fuel flow, and burner construction should be such that liquid fuel will not accumulate or seep through the engine.

4. Carbon accumulation should be minimum in the burner, particularly on the spray nozzles.

5. Since for many duties relatively volatile fuels may have to be used, precautions must be taken against vapor lock.

Although the author does not claim that all of these requirements have been achieved as yet, he feels that in time they certainly will be. As evidence, he revealed that clean, compact combustion, wide range of inflammability, and positive starting under such adverse conditions as, for instance, 1200 to 1 total *A/F* ratio has already been accomplished in his own laboratory.

In addition to suggesting a detailed comparative rating of merit for different burners to enable experimental workers to appraise their models against other American and foreign types, the author set forth in simple, easily visualized forms, the essential factors of jet engine combustion, and gave some idea of the broad possibilities of improvement that exist in the use of graduated air velocity, controlled turbulence, and impact heating spray.

DISCUSSION

Lloyd E. Berggren, Wright Aeronautical Corp., in a discussion read by E. V. Farrar, suggested two more burner characteristics that should be included in rating any burner designed to operate in a jet engine or gas turbine. He discussed these as follows:

1. Burner discharge temperature pattern, expressed as a percentage variation from the mean. Inadequate mixing of primary and secondary air will reduce somewhat the turbine efficiency, since it was designed to operate on a gas of uniform temperature. Furthermore, localized heating resulting from poor discharge temperature patterns may adversely affect turbine durability.

2. Burner durability:

   a. Structural.

   b. Ability to maintain initial combustion efficiency.

This point is mentioned because it is true that in some existing burners efficiency decreases with running time as a result of structural deformations, atomizer wear, and/or carbon deposition.

The two most important requirements of a combustor, D. G. Samaras, National Research Council of Canada, pointed out, are a high combustion efficiency and a low pressure loss, although small bulk and weight are universal requirements of aircraft elements.

Tests made in the Royal Aircraft Establishment show that these two requirements are interchangeable, he reported; so that for a given weight and bulk of combustor, a high efficiency is achieved at the expense of high total head pressure losses, and vice versa.

Mechanical Design Considerations Influencing Blading Performance in Aircraft Gas Turbine Powerplants – **NATHAN C. PRICE, Menasco Mfg. Co.**

ALTHOUGH it might seem off-hand that the design of blading would be about the same whether it was to be used for compressors or turbines, Mr. Price explained that, at the same pressure ratio, several stages are required in a compressor to obtain the same efficient performance that the turbine produces in a single stage. It follows that in the compressor utmost care must be taken to avoid minor protuberances obstructing flow, and the airpressure must be boosted in small increments involving moderate changes in direction of flow in each blading row.

The author is definitely in favor of hollow blades or buckets, particularly those with tapered walls. Such blades, he said, afford an opportunity for better control of natural frequency without entailing excessively thick blade sections, which, particularly in a compressor, might reduce efficiency. He also mentioned that compressor or turbine blading may be provided with an additional twist to offset errors in angle of incidence resulting from centrifugal load couples or creep.

Compressor blades are best made of a hard, erosion-resistant material to prevent loss of efficiency in service. Mr. Price explained that some otherwise desirable airfoil sections are unusually susceptible to performance reduction caused by surface roughness. It is best to employ material that can be given a good, permanent polish by buffing, such as steel or age-hardening monel, he added.

Blade tip clearance in axial-flow compressors, Mr. Price warned, should be kept as small as possible to improve performance. He explained that the advantage of using hollow tip or other "wear" structure is that serious damage cannot occur if blades rub the casing. Such a construction, he said, has been used in the past on some steam turbines. In a typical compressor, he added, an initial tip clearance of about 1/2000 of the blading tip diameter is applicable in the cold condition.

DISCUSSION

Use of regeneration as a possible substitute for high compression ratios, as mentioned by Mr. Price, was pointed out by W. C. Lundquist, Wright Aeronautical Corp., to have its disadvantages. From studies made of a specific propeller turbine engine, he concluded that, first, regeneration pays off best near zero airplane speed, and rather rapidly loses effectiveness as higher speeds are attained; and second, weight increases chargeable to regeneration are rather large. Although these conclusions were drawn from a particular design, he felt sufficiently sure that they are indicative of a general trend to have his enthusiasm for regeneration dampened considerably.

Taking issue with the statement of the author that multistage compressors of either type should peak over 90% efficiency, D. G. Samaras, National Research Council of Canada, said that for a compressor of 4:1 pressure ratio and 87% small stage efficiency, the overall efficiency is slightly higher than 84% and for 90% small stage efficiency it is about 88%.

The 87% and 90% small stage efficiencies have been considered by the Royal Aircraft Establishment of England to be the upper and lower limits of aircraft compressors, he continued, and the Germans in their designs were even more pessimistic.

Air Transport

All-Weather Flying Facilities – E. A. CUTRELL, American Airlines, Inc.

(Paper presented by R. T. Ayer, American Airlines, Inc.)

ONE of the most important problems facing the air transport industry is that of deciding what facilities are necessary to complete schedules and to control traffic in the best possible manner during the next few years, for until this step is taken, Mr. Cutrell emphasized, the industry cannot carry out the next step of making plans for the installation of the required facilities.

What approach and runway lights are needed? How best can traffic be controlled and landed at congested terminals? Such are the questions considered by Mr. Cutrell in an effort to provide some of the discussion that will help to solve the problem.

Approach and runway lighting is still so important, the author explained, because, despite much talk of automatic landings by radio, radar, or electronics, airline pilots of this generation will make their landings visually. Despite this importance, Mr. Cutrell revealed that he considered only two airports in this country have runway lights adequate for all-weather landings, and not one has approach lights suitable for operation in much lower than present weather minimums.

In general, he said, approach lights should be visible through a wide lateral and vertical angle and the lights should be distinctive both in daylight and at night, so that pilots can't possibly mistake them for other lights and obstructions.

Control and landing of traffic at congested terminals must also be overhauled, according to the author, who said that even the instrument landing systems now being installed do not provide a solution to this problem. He suggested that these very-high-frequency landing systems need the addition of two low-powered radio beacons, one located at the middle marker site 3500 ft from the end of the runway and the other at the outer marker site 4½ miles from the end of the runway. These beacons, he claimed, would simplify the technique of weather approaches and would provide a complete means for an instrument letdown if either the ground or airborne vhf glide path, localizer, or markers became inoperative.

DISCUSSION

In reply to a question asked by Chairman Gilbert, Mr. Ayer said that there are enough frequencies available so that two can be picked for an airport, with other frequencies sufficiently far removed still being left for nearby airports, so that interference will not occur. If only the markers on the approach being used at an airport needing two or three approaches are turned on, he explained, it is possible to have all inner markers at the airport at the same frequency and also all the outer markers at the same frequency.

He was highly enthusiastic about the automatic direction finder. It is an instrument of many uses, he said, and because it uses the low frequencies now installed on ground facilities, even private flyers should be amenable to buying it. It eases the load on the pilot, he continued, and facilitates flying the holding pattern. Even though it is heavy and costly, he feels that this equipment has a promising future.

The suggestion of W. H. Hunter, NACA, that the same frequency be used at all airports, with low power to keep down the interference, was considered a possibility by Mr. Ayer, who felt that tests along these lines should certainly be made.

If the homing stations are properly placed, Mr. Ayer pointed out, high-speed planes will be able to use the pattern suggested without any trouble. A distance to outer marker site of 3½-5 miles should take care of both high- and low-speed planes, he said.

There is a problem to be solved in holding planes with little fuel reserve to the pattern, Mr. Ayer admitted. To take care of this contingency, he suggested that in time holding must be practically eliminated.

John G. Lee, United Aircraft Corp., asked if the author contemplated both private and airline planes using the same airport under these conditions. Mr. Ayer replied that he saw no reason why such private airplanes as were properly equipped could not come into a holding pattern for landing under the conditions contemplated.

Contrary to popular belief, winds are high and gusty, particularly in winter, under conditions when instrument landings are necessary, Mr. Ayer told Peter Altman, consulting engineer. He pointed out, however, that during the period of holding, the pilot will be able to catalog these winds. The only problem left will be that of correcting for change in angle and velocity of winds as he descends.

All-Weather Flying Technique – JOHN F. GILL, Eastern Air Lines, Inc.

IT was not until about 1928, when the correct way to use the turn indicator was discovered, that a pilot could enter a cloud with a reasonable expectancy of emerging on the opposite side with sky and ground in their normal relative positions, and on a more or less straight flight path. Before that, Mr. Gill explained, pilots usually maintained normal flight attitude by reference to the horizon or some other fixed object – not the safest system, particularly for the inexperienced pilot.

In these early days, the author continued, airway scheduled flying was accomplished without benefit of ground navigational aids other than rotating beacon lights every 10 miles and lighted emergency fields every 30 miles.

Fortunately, radio ranges were in the process of installation, rendering obsolete the ground-level-plus technique. These radio ranges were of the four-course, low-frequency, loop antenna type, a system, the author said, that left much to be desired, but that did permit navigation through bad weather at a safe altitude.

In time several methods of achieving partial or total blind landings were developed, but none was adequate when used alone, the author explained.

He reported, however, that restrictions as to ceiling and visibility for landings and take-offs can be eliminated with the use of equipment already available. He pointed out that the installation would consist of localizer and glide path, runway and approach lights, and two compass locator stations. This system can be designed so that failure of one part does not affect the safety of the system as a whole. In addition, the system is simple to fly and requires little training.

Icing was also discussed by Mr. Gill, who stated that intentional flight through severe icing conditions cannot be accomplished with safety using present-day equipment. Continuous use of boots, for instance, often results in formation of rough lumps of ice that adhere and increase in size. Good flight technique, the author stressed, is an important factor under icing conditions.

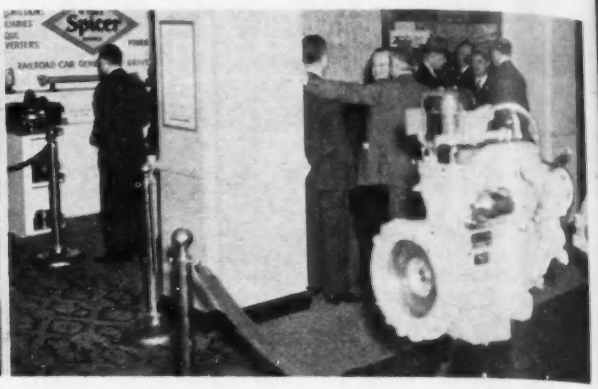
Thermal de-icing, new high-speed, high-altitude planes operated with advanced flight and dispatch techniques, greater choice in flight altitudes through cabin pressurization, "area flying," and high-frequency radio ranges were all suggested by the author as useful in overcoming icing conditions.

DISCUSSION

Pointing out that in thermal systems of de-icing, both the speed and the power of the engine are involved, one member of the audience asked if revisions in design performance are being taken into consideration in the development of flight techniques for de-icing. Mr. Gill said that they will be, stressing that present de-icing equipment is still most inadequate.

Pilots would much rather have all the information that they need for landing in a form that they can see before them in the cockpit, Mr. Gill told Chairman Gilbert, rather than have facilities only at the airport, which brings the pilot in by directing him how to land. Some form of ground radar is useful, however, he said, to help those pilots land who do not have facilities in their planes for taking care of themselves, otherwise such pilots might well gum up traffic.

Largest Engineering Display in SAE Annual Meeting History Draws Record Interest



Review of Air Transport Developments in America — R. D. KELLY, United Airlines, Inc.

IN a most comprehensive paper, Mr. Kelly reported on the progress of civil air transport during 1945, referring in particular to the principle contributions that have been fostered by the youngest of the SAE activities, the Air Transport Engineering Activity.

One of the significant advances discussed by Mr. Kelly was the increases that the airlines have made in their engineering staffs. These staffs, he said, will play an important part in analyzing the many new civil design proposals that are being offered to the air transport operators from every side, for these staffs have learned to talk the same language as the manufacturers' sales and design engineers. They can write detailed specifications which mean something for the airline and which are not unreasonable for the producer.

Much of the discussion during recent months, Mr. Kelly reported, was centered around the proper gross weight for transport airplanes. Since it has now been demonstrated that airplanes of tremendously high gross weights can be built and flown, the operators are faced with the problem of selecting a size of unit that provides a most economical cost per ton-mile and that provides the most acceptable service for the passenger and shipper. The author said that, in general, for a given service the airplane should be no bigger than required for good economy between any two points and should provide the maximum frequency of service consistent with the volume of traffic available.

Airworthiness standards for civil aircraft were of interest to air transport operators during 1945. Mr. Kelly mentioned that as a result of cooperation between the Government and various industry organizations, the C.A.B. has now approved a forward-thinking set of regulations that, while increasing safety, permits the more complete utilization of such new developments as may be proposed from time to time.

The war, Mr. Kelly also explained, gave impetus to automatic flight control and instrument landing developments that promise to improve schedule reliability and safety to a considerable degree.

Report on the German Commercial Airline: Deutsche Lufthansa — O. E. KIRCHNER, American Airlines, Inc.

LACK of development work and standardization as compared with American commercial airlines was noted by Mr. Kirchner in the observations he made as part of a team of airline experts that went to Germany for three months in the summer of 1945.

The only commercial German air carrier was the Deutsche Lufthansa, which, Mr. Kirchner related, was so completely subsidized by the Government as to make it in effect a Government agency.

The lack of standardization seemed to stem from the variety of airplanes and engines used, he said, adding that to make matters worse, most of the equipment was outmoded, only a few of the newest landplanes being in operation.

Volume of traffic handled, he reported, was small in comparison with American standards. Similarly, passenger service was generally inferior to that offered by American airlines, although the Lufthansa did have one type of passenger service that is not offered in this country; namely, a public service message service aboard aircraft. Messages filed by passengers would be transmitted by the operator, who would transmit them to a ground station, which would turn them over to the telegraph agency. Cost was high and the service was cancelled during the war.

It was necessary to carry a radio operator on all flights before the war because radio-telegraphy was the only communication system between ground stations and aircraft, he stated further. During the war, though, radio-telephone equipment was available in limited quantities.

Maintenance and overhaul procedures, he said, differed little from conventional methods employed by American airlines. Overall production was low, caused at least in part by failure to standardize equipment. Ground servicing crews, however, were very efficient, reliance being on knowledge and craftsmanship of the older maintenance men.

Considerable ingenuity was displayed by the Germans in the design of such devices as fluid connection safety locks, flush-type cowl and leading edge fasteners, and other devices facilitating servicing of aircraft.

Lufthansa had much experience with diesels, which they had used extensively on their South Atlantic route, the author said. The Junkers Jumo 205 engine they had used, had certain difficulties, however, with pistons at high power outputs.

The Germans made extensive use of electric power in aircraft, the standard system being 24 v, d-c.

DISCUSSION

The German designers had to give up their work on flying boats during the war, Mr. Kirchner explained in answer to a question from Chairman Froesch, because all skilled men were needed by the military.

Interest was shown in the widespread use by the Germans of an electrical system for windshield de-icing. W. H. Hunter, NACA, expressed the thought that it would not be in favor with pilots because of the series of wires across the glass that would disturb vision.

PRODUCTION SESSION

L. V. Cram, Chairman

The single production session at the annual meeting was concerned with two currently vital topics: air fixtures and air controls and honing techniques. Excellent attendance and intense interest were features of the session.

Air Fixtures and Air Controls — S. JOHNSON, JR., Bendix-Westinghouse Automotive Air Brake Co.

AIR-OPERATED fixtures offer the great advantage of labor economy, as compared to manual or mechanical operation, Mr. Johnson reported, when applied to shop production, and in actual use have established their worth by promoting worker safety and by increasing production per man-hour.

Experience has shown, he said, that it is possible to use 375 air-operated fixtures with the air supply from a two-stage, steam-driven air compressor having a displacement of 992 cu ft and a volumetric efficiency of about 85% at 125 psi. He estimated that the 375 fixtures consume only about 15% of the total amount of compressed air used in the plant.

Application of brake chambers to pneumatic inspection tests of relay valve assemblies has resulted in a production increase of more than 100%, according to Mr. Johnson. Application to a hydraulic arbor press, operated by women, has enabled the workers to produce

10 times as much daily and with minimum fatigue. Application to the process of babbitting compressor connection rods has resulted in savings the first year of $5800 in production costs plus the cost of installation. Use of clamping fixtures, he concluded, has eliminated securing by bolts and nuts for production running tests of compressor assemblies with resulting savings of 1½ min per cycle and yearly labor savings of about $5000.

***Latest Developments in Honing Techniques*—LAWRENCE S. MARTZ and DOUGLAS T. PEDEN, Micrometer Hone Corp.**

(Presented by Mr. Peden)

MODERN honing can remove as much ferrous metal as finish boring or grinding in a shorter time and at reduced costs, and can also assure increased product quality control, the authors revealed. New developments in the honing technique assure the generation of finer accuracy, low tolerance control of uniform size, rapid and heavy stock removal, and production of any desired kind or type of functionally characterized cylinder bore wall quality.

Reproducible, uniform accuracy in modernizing honing applications in bores above 4 in. in diameter, they said, is held within 0.0005 to 0.001 for roundness and straightness; in bores from 4 in. in diameter to 1 in. in diameter, within 0.0003 to 0.0005; and in bores below 1 in. in diameter well within 0.0003, and even as low as 0.00005.

Recent development the authors stated, is heavy stock removal by the hone abrading method using thousands of simultaneous cutting contacts. Twenty-five to 30 times as much metal is removed than formerly was practicable, and the work is done six to eight times as fast.

It is the function of modern honing techniques, the authors said, to provide any kind of surface finish and bore wall quality that may be desired, including multidirectional patterns. They believed that these techniques provide greater economical control and reproducibility of the final processing result than ever before has been possible, and minimize the quantities of metal removed.

DIESEL ENGINE SESSIONS

Chairmen

W. A. Parrish — **G. M. Lange**

Fuel and combustion studies again were the center of interest at the two diesel-engine sessions. Prepared discussions played important roles in these gatherings and resulted in an unusually broad consideration of the specific technical problems at issue.

***Combustion Studies of the Diesel Engine*—E. W. LANDEN, Caterpillar Tractor Co.**

WARTIME demand has had a disturbing effect upon diesel fuels Mr. Landen reported. Production of premium fuels has increased, he said, leaving a large surplus of fuels having cetane below 40 and thereby producing new problems in starting and maintenance. Simultaneously, increased thermal and catalytic cracking facilities produce large volumes of diesel fuels which have desirably low pour points, but inferior auto-ignition qualities.

In order to augment knowledge of the reactions of engines to fuels of known origin and composition, the author pointed out that tests are being made with 12 diesel fuels of cetanes 40, 55, 70, and 90, each in the 400-500F, 500-600F, and 600-700F distillation ranges. These fuels, representing the extremes in distillation and cetane of the usual diesel fuels on the market, are tested in single-cylinder, liquid-cooled diesels, one of a precombustion chamber type fitted with pressure pickup outlets and with windows for observation. The other engine is of the direct injection type, fitted with interchangeable pistons having hemispherical craters and giving, respectively, compression ratios of 15 to 1 and 12 to 1.

Tests of this series of narrow distillation range fuels, representing Part I of diesel-engine combustion studies, have produced, Mr. Landen continued, among others, the following data:

- Cetane is a straight-line function of the paraffinic content.
- Specific fuel consumption is almost a straight-line function of distillation range.
- Combustion flame duration of a fuel in an engine cylinder depends upon cetane; higher cetane fuels produce the longer visible flame; distillation range influences the duration of combustion slightly, if at all.
- Exhaust smoke is a function of bmep; retarded timing causes smoke to appear at smaller values of bmep; fuels of the 400-500F distillation range and low cetane produce less smoke.
- Ignition delay is greater in fuels of the higher distillation ranges.

Other tests still in progress were said in Part II of the report to have produced some qualitative results on fuels having specific characteristics, and to suggest that:

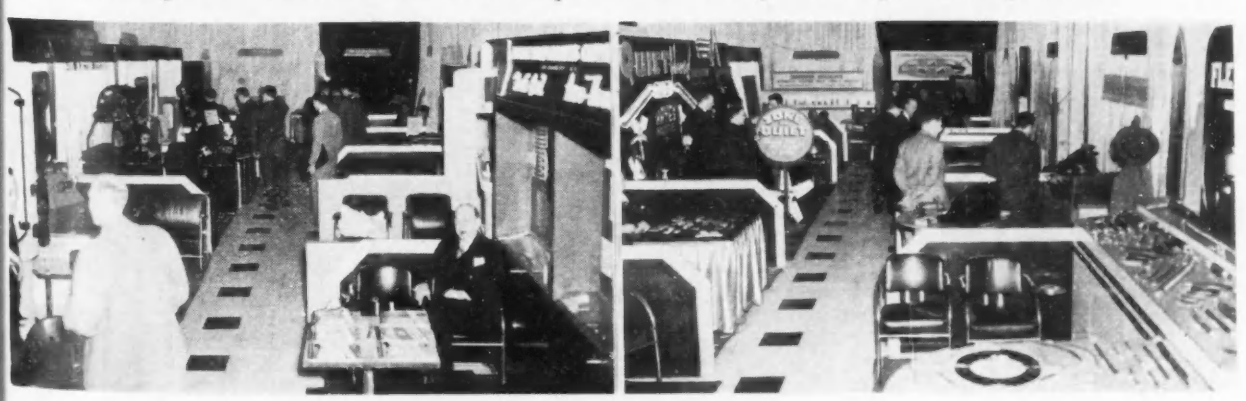
- Initial oxidation, or preflame reaction, proceeds at a rate related to cetane.
- Flame temperature is difficult to measure; experiments now are being made with a photoelectric pyrometer.
- Emission spectroscopy has produced spectra which tend to confirm flame duration measurements.
- Absorption spectra indicate chemiluminescense and radiation from incandescent particles believed to be heated carbon precipitated by explosion; additional experiments will be made to ascertain whether carbon continues to be precipitated throughout longer injection periods.

DISCUSSION

Part I findings were characterized by Grover C. Wilson, Universal Oil Products Co., as timely contributions to better mutual adaptation of fuels and engine, especially since the demand for furnace oil for both oil burners and diesels has increased in much greater proportion than the demand for gasoline, with the result that the supply of straight-run distillate must be augmented by cracked distillate. Damage to ignition properties is appreciably less by catalytic cracking than by thermal cracking, he added, particularly because catalytic operating conditions may be controlled over comparatively wide limits and permits of alteration of fuels properties.

Mr. Wilson summarized research findings to show that the paraffins have the highest ignition qualities, the aromatics and naphthenics the lowest, with the olefinic com-

Additional Space Provided for Industry to Show Engineering Developments



pounds accorded medium to high rating. He said that despite dissatisfaction with cetane number as a yardstick of diesel fuels quality, it will have to serve until something better is found.

Detonation in spark-ignition engines and fuel knock in compression-ignition engines are not direct opposites, Mr. Wilson commented. In both engines preflame reactions must be controlled. These controls, however, were said to be opposite, ignition delay being sought in the spark-ignition engine, ignition hastening in the diesel.

"There is much talk of improving engine operation by the use of an extremely high cetane fuel," asserted Mr. Wilson. "The answer will not be forthcoming until someone develops an engine to take full advantage of such fuel."

Effect of Fuel Properties on Diesel Engine Performance – F. G. SHOEMAKER and H. M. GADEBUSCH, Detroit Diesel Engine Division, General Motors Corp.

(*Presented by Mr. Shoemaker*)

INTENSE commercial development of new refining processes during the war has caused a reorientation of the liquid fuel situation, according to the authors. For the first time in the history of internal-combustion engines, they said, fuels refining has advanced into the realm of unlimited possibilities and is stimulating interest in the direction of further progress in engine design now that fuels of any desired characteristics are available.

Studies of fuels and combustion made by the Detroit Diesel Engine Division indicate, the authors reported, that wide variation of fuels properties normally associated with fuels burning characteristics is of insignificant influence on combustion in the General Motors two-cycle, direct-injection diesel under normal load and speed conditions. These studies suggest that the power developed in a diesel is directly proportional to the heating value of the fuel injected and is independent of its cetane rating, volatility, chemical composition, and molecular structure. However, both cetane and volatility have marked effects upon cold starting and light load operation when the ignition capacity of the cylinder is reduced.

It is becoming obvious, the authors related, that one of the main factors governing diesel fuels requirements is the type of service in which the engine is operated, and these operations should be considered as the criteria by which automotive diesel fuel specifications are established. Studies indicate that the major properties of diesel fuels are: (1) ease of vaporization, (2) ignition, and (3) chemical composition.

"Many diesel engine operators," they commented, "have reached the important conclusion that low quality, low cost fuels are not necessarily the cheapest in the long run. The operational life of an engine may be shortened as much as 50% by use of fuels unsuitable for the type of service encountered."

DISCUSSION

Henry Barnett, NACA Laboratories, presenting a written discussion prepared by H. C. Foster, also of NACA, in lieu of that scheduled by A. M. Rothrock, described the results of testing diesels with gasoline-fuel-air mixtures which were said to assure smoother and quieter operation despite the low cetane number. Conclusion was reached that cetane number is not a reliable measure of fuels performance in diesel engines.

Combustion in a Precombustion-Type Diesel Engine – HARRY F. BRYAN, International Harvester Co.

SINCE 1938 high-speed motion picture studies of diesel engine combustion have been carried on to ascertain spray form, spray penetration, and combustion, and to view combustion through windows in the cylinder of a diesel. Mr. Bryan reported that these photographic studies have revealed that vaporizing time occupies more than a 120-deg crank angle and that both turbulence and heat of combustion must be added to the spray in order to shorten the vaporizing period. Total burning time, he said, is four times that which can be tolerated in the engine, yet is characteristic unless and until turbulence diffuses fuel vapors as fast as they form.

Mr. Bryan explained that maximum rate of burning should occur in the last half of the combustion period for satisfactory detonation control and optimum smoothness of operation, as contrasted with a requirement for maximum rate of burning in the first third of the combustion period of the spark-ignition engine. Combustion control is tending to become an important factor in diesel operation, Mr. Bryan said, and the development of more accurate instruments, determination of the rate of fuel injection under engine operating conditions, and recording of accurate indicator cards are mandatory for progress.

"At the present time," commented Mr. Bryan, "diesel combustion data from different tests are not correlated. Any results must be considered as being limited to a particular engine operating on a particular fuel at a particular time. I hope that sometime we can get together, as the gasoline engine men have done, and produce correlated tests."

DISCUSSION

Combustion control is becoming a major factor in diesel operation, particularly since the higher rpm demand is increasing, commented H. M. Wiles, Waukesha Motor Co., adding that selecting the best air swirl and injection rate for a given range of operating speeds to obtain optimum performance at rated speed is a problem customarily solved by compromise between the best rated speed setting and a permissible rate of pressure rise at the lower speeds.

Current Waukesha design was said to incorporate compression turbulence during the initial combustion period and combustion-induced turbulence during the final combustion. This feature, Mr. Wiles explained, permits operation over a wide speed range with a fixed injection pump timing, as the turbulence and speed of burning is proportional to the crankshaft rpm, and also gives clean exhaust from light to full loads.

FUELS & LUBRICANTS SESSIONS

Chairmen

J. C. Geniesse — **M. O. Teetor**

One session devoted to Fuels and one to lubricants comprised the F&L contribution to the annual meeting program. A discussion started long before the meeting on regular, premium, and heavy-duty motor oils was the basis for one lively session, while two reports from Coordinating Fuel Research Committee groups comprised the other.

Motor Oils – Regular, Premium and Heavy Duty – H. R. WOLF, Research Laboratories Division, General Motors Corp.

CONFUSION in nomenclature resulting from wartime development of heavy-duty lubricating oils containing oxidation inhibitors and detergent-dispersant compounds and variously refined to incorporate special service characteristics is believed to be corrected by separately defining three generally used types of crankcase oil as "regular," "premium," and "heavy duty." These names and definitions were adopted by the American Petroleum Institute's Division of Marketing after consulting with and receiving recommendations from the SAE Standards Committee, Lubricants Division; Coordinating Research Council Assignment Committee, Coordinating Equipment Research Committee, and Coordinating Lubricants Research Committee; Automotive Engine Oil Section, Technical Committee B, ASTM D-2; and other interested groups.

In the approved nomenclature, "regular" designates a straight mineral oil of the type generally suitable for use in internal-combustion engines under moderate operating conditions. "Premium" designates oils having proved oxidation stability and bearing corrosion preventive properties, and which are suitable for use in internal-combustion engines where operating conditions are such that regular oils give unsatisfactory service. "Heavy duty" designates oils having proved oxidation stability, bearing corrosion preventive properties, and detergent-dispersant characteristics. Oils of this type generally are suitable for use in both high-speed diesel and gasoline engines under heavy-duty service conditions.

These definitions, however broad, do not directly enumerate all

properties or characteristics inherent in each of the several types of crankcase oils, nor have inspection limits been written into the definitions. For instance, "regular" motor oils, to achieve such classification must be properly refined and possess all required properties to the degree necessary to satisfy moderate operating conditions. "Premium" oils must, in addition to those required, possess supplementary performance characteristics ensuring satisfactory operation under more severe service conditions. "Heavy duty" oils must satisfy extremes of service conditions and should meet at least the minimum requirements of U. S. Army Specification 2-104B or U. S. Navy 9000 Series.

The new nomenclature used in conjunction with the SAE Viscosity Numbers, it was explained, will enable automotive manufacturers to recommend to owners of cars, trucks, and buses the type of oil best suited for use under different operating conditions as well as the correct viscosity grade required by climate. Opinion was expressed that the definitions, when interpreted from the viewpoint of the different groups responsible for their formulation, adequately describe the performance characteristics of the three types of commercial automotive crankcase oils and will assist refiners in compounding suitable products for service under different field conditions. Further, it was said, the definitions will encourage the marketing of outstanding products, and will permit improvements in quality in commercial lubricants without requiring a corresponding change in the approved text.

DISCUSSION

As predicted by Mr. Wolf, discussion developed dissatisfaction with many aspects of the classifications and nomenclature, although admission freely was made that some semblance of order should be introduced into the present chaotic situation.

Tests of heavy-duty and other oils so far conducted, as well as the proposed classifications, overlook other important factors, such as fuels, engines, temperature and contamination, according to Carl Georgi, Quaker State Refining Co. He said that the tests, as reported, were run at high speeds and loads and while heavy-duty lubricants perform best under such conditions, vehicles in service seldom operate at service peaks. Among other results, he added, is that dirty engines can develop with heavy-duty lubricants, which, consequently, do not always live up to their reputation.

John E. Wilkey, Cleveland Graphite Bronze Co., speaking in place of Max Roensch, of the same company, commented that not all engines demand premium or heavy-duty oils, although the use of these lubricants generally may be expected to improve performance.

Need for adoption by the automotive and petroleum industries of a common language, accurately descriptive of lubricants, which could be used both in technical discussions and in presentations to customers, was suggested by G. A. Round, Socony-Vacuum Oil Co. Need exists also, he added, for defining the oil-use requirements of engines and for correlation of tests which currently reveal many vagaries.

The classifications were characterized by A. O. Willey, Lubri-Zol Corp., as a definite forward step toward indicating the nature of the type of oil needed for specific uses. Mr. Willey said that operating conditions similarly should be defined, so that all might agree whether such conditions are "light," "medium," or "heavy" and call for corresponding lubricants.

The proposed nomenclature fails to identify lubricants by their respective characteristics, commented T. C. Smith, American Telephone & Telegraph Co., pointing out that heavy-duty oil, because of its detergency, might be desirable for light as well as heavy-duty service. He recommended that the lubricant be called "detergent oil" because detergency is its chief identifying characteristic. Mr. Smith reported progress in efforts to develop consumer specifications for lubricants, particularly as regards viscosity, oiliness, and oxidation or thermal stability.

More work should be done on terminology not only of crankcase oils, but of gear lubricants, said J. A. Jones, Kendall Refining Co., who pointed out that there are, currently, eight different ways of identifying BBL761 lubricants. He suggested that the automotive and petroleum industries cooperate in developing and naming new lubricants and in defining their proper uses, thus eliminating the present confusion caused by such instances as identifying gear lubricants as "mineral oil," "extreme pressure," "mild extreme pressure," "powerful extreme pressure," "hypoid," and otherwise.

Gasoline Gum Tolerance of Ordnance Equipment (Report of CFR Committee) — M. L. ALSPAUGH, Ethyl Corp.

FIELD tests made by the Gasoline Additives Group of the Coordinating Research Council's CFR Motor Fuels Division at the request of the Ordnance Department have indicated that the gum content of gasoline fuels must be kept below 7 mg to ensure freedom from excessive engine deposits in continuous use of military units. Marked differences were noted between fuels containing 1.5 mg to 7 mg; insignificant differences between fuels containing 7 mg to 50 mg.

Objective of the tests was to determine the maximum limit of gum in fuels aging in storage under various atmospheric conditions. Two tests were conducted between October, 1944, and January, 1945, and April to June, 1945, at Camp Bullis, San Antonio, Texas, on ¼-ton 4 x 4, ¾-ton 4 x 4, 2½-ton 6 x 6, and 4-ton 6 x 6 trucks and on an M24 light tank, M4A3E8 medium tank, and M-18 motor gun carriage. The third test was made with stationary Ordnance engines, including four power units, one battery charger, and one pumping unit.

First test of mobile units, conducted in ambient temperatures averaging 50F, involved operation of the wheeled vehicles for 5000 miles over 21 miles of normal highway and two miles of hilly cross-country. The tracked vehicles were operated 100 hr over 13 miles of packed gravel roads and seven miles cross-country. The second test of mobile units, with ambients above 70F, covered the same courses, with 10,000 miles for the wheeled vehicles and 150 hr for the tracked. Operations called for intermittent periods of part- and full-throttle and high- and low-speed driving, with idling and cooling periods, plus a simulated dead storage test calling for a highway run of only two miles a week. The stationary units were operated continuously at recommended load for 500 hr or until failure. These tests were held at San Bernardino, Calif., from August 9 to September 8, 1945. Test fuels were prepared by blending 2-103B specification gasoline with high-gum, uninhibited, naturally aged, cracked stock.

The first mobile test revealed no significant differences in engine deposits or cleanliness between vehicles operating on 10 mg and 25 mg gum fuels. Three vehicles were operated on 1.5 mg fuels, six on 10 mg, and three on 25 mg. Deposition was heavier in intake ports and intake valve tulips, but no vehicle accumulated deposits sufficient to demand extensive repairs. All fuel systems were clean and free with the exception of the choke valves of one vehicle being stuck open on 25 mg fuel. Vehicles in simulated dead storage showed no signs of gum formation.

Results of the second test, in which fuels containing 1.5 mg to 50 mg gum were used, indicate that fuels containing 10 mg, or more, ASTM gum cause excessive engine deposits which may shorten satisfactory operation. Of the 30 vehicles, 28 finished the 10,000-mile test without serious difficulty. Two wheeled vehicles failed because of deposits on intake valves. Two others finished with some difficulty because of sticking choke valves and erratic operation of the piston in the vacuum-operated downshift mechanism of the transmission. The test further revealed that wheeled vehicles tested may be operated up to 5000 miles on fuels containing 10 mg or more gum, but engine failure thereafter may be expected, whether gum content is 10 mg or 50 mg.

The stationary units were tested with fuels of 1.5, 7, 10, 25, and 50 mg gum content. Results substantiated those of the second road test, especially that fuels containing 7 mg or more gum cause excessive deposits and that high-gum fuels shorten satisfactory operating life. Heavy black deposits were found in intake manifolds and ports, on intake valve stems above the guides, and on intake valve tulips. Varnish formed increasingly on valve stems, pistons,

cylinders, valve cover plates, and oil pan sides. Failure of engines to complete the 500-hr test was ascribed to excessive deposits on intake valve tulips and in the ports and to sticking of intake valves.

DISCUSSION

Successful determination of the gum tolerance of Ordnance vehicles, described by Mr. Alspaugh, permitted the maximum use of depreciated stocks of fuels overseas and prevented operational difficulties which might well have resulted in serious consequences under combat conditions, commented Capt. Norman L. Klein, Office, Chief of Ordnance. Capt. Klein expressed the gratitude of the Ordnance Department for assistance in planning the tests and for providing technical personnel.

In a combined discussion, Com. C. J. Livingstone, USNR, and E. J. Gay, Ethyl Corp., both consultants to the War Dept., declared the gum tolerance tests confirmed the earlier recommendations of Coordinating Research Council's War Advisory Committee that gasolines below 10 mg ASTM gum would be satisfactory for any service and that gasolines of 10 to 15 mg ASTM gum might be used for noncombat vehicles, but not small stationary units. They reported satisfactory field experience in the North African, Mediterranean, and CBI theaters, and suggested that, on wheeled military vehicles, a large percentage of gum comes out on the inlet manifold hot spot, provided temperatures here are high, and, otherwise, in the inlet port and on the under side of the inlet valve. Field observations were said also to indicate that gummy gasoline, or fuel of low inherent stability, may cause light but troublesome deposits on exhaust valves, thereby inducing valve sticking and burning.

P. V. Keyser, Socony-Vacuum Oil Co., Inc., suggested that the noticeable lack of differences in results between 7 mg and 50 mg gum content and between 1.5 mg and 7 mg raises questions which point to the advisability of additional testing.

A Review of the Development of Reference Fuel Scales for Knock Rating (Report of CFR Committee) — **D. B. BROOKS, National Bureau of Standards.**

STUDY and development of the art of knock-rating fuels, extending over a quarter century, has made apparent that no single scale will satisfy all needs and that requirements demand a scale in terms of which fuel-blending computations readily can be made and an interchangeable scale to express relative engine performance.

Exploratory work of the Aircraft Fuel Knock-Rating Scale Group, CFR Aviation Fuels Division, Coordinating Research Council, suggests that a leaded triptane-heptane scale offers much promise. This scale, described as expressible either as triptane number or detonation index, is extensible with accuracy to the upper limit of antiknock quality, thereby affording adequate coverage, and definitely is superior in important respects to present reference fuel scales. Research now under way is expected to provide information upon which adoption of this scale can be based.

The LTrH (lead-triptane-heptane) scale, designed to replace that employing the outgrown octane numbers, establishes a linear relationship between the reciprocal of the knock-limited imep and the fuel composition of the reference fuel, permits extrapolating to the scale's infinity with small chance of error, and provides, for the first time, a continuous scale covering the range of all present and prospective aircraft fuels. The ratio of knock-limited imep of any LTrH blend readily can be found. When multiplied by 100, this ratio gives a detonation index indicating the relative performance of fuels in a test engine. This index is continuous, logically extensible to any desired limit, can be determined physically on the test engine, and may be correlated with any scale. It is suggested that the detonation index replace the AN performance-number scale, useful range of which already has been surpassed by experimental fuels, particularly because performance numbers are identical both in principle and in practice with the proposed detonation index.

Opinion was expressed that, should the triptane scale be adopted for use with aviation fuels, its application to motor fuel test methods should be studied. Both scales now under study were said to display such attributes as continuity, constancy of tetraethyl lead content, and sensitivity approximating that of conventional aviation fuels.

DISCUSSION

H. C. Barnett, NACA, warned that not too much confidence should be placed upon apparent relationships between factors even when results are inviting.

The proposal to adopt a new yardstick based upon leaded mixtures of heptane and triptane is sound and logical, according to Wheeler G. Lovell, Research Laboratories Division, General Motors Corp., and the scale appears to be long enough. Two basic facts apply to the use of fuel reference scales, he added, first that some fuels are better than others in respect to knock, and some numerical scale telling how much better would be helpful; and, second, how much better a fuel is depends upon the engine in which the comparison is made.

S. D. Heron, Ethyl Corp., said in a written discussion that the leaded triptane-heptane reference fuel scale is much the best offered to date for aviation fuels although, like all suggested scales, its sensitivity varies considerably with the amount of triptane present.

Any new system of primary reference fuels which is adopted should be independent of the system which it replaces, in the opinion of Robert V. Kerley, Ethyl Corp., who declared that this cannot be true with the detonation index, which would effectively nullify any system of reference fuels because the test fuel rating would be relative only to iso-octane. Mr. Kerley proposed simplification by redefining the value for expressing relative performance in terms of the proposed reference fuel, such as:

$$\text{Value expressing performance} = \frac{\text{Imep of test fuel}}{\text{Imep of 65.5\% LTrH}}$$

Such a ratio, he explained, has the advantage that the new primary reference fuel is actually independent of the reference fuel it is replacing.

Dr. W. J. Sweeney, Standard Oil Development Co., described wartime experiences in supplying aviation fuels and remarked that the Germans had developed a system of measurement which utilized leaded reference fuels and took advantage of the many apparent benefits. He said indications are that the forthcoming sets of reference fuels will work satisfactorily in testing 99% of commercial fuels, and expressed the interest of industry in the tests because an extremely narrow margin in results could make a 20% difference in fuels production.

Dr. Sweeney commented that the detonation index is not entirely satisfactory, since it is not linear with existing scales and not applicable to some. Characterizing the detonation index as "just another translation," Dr. Sweeney proposed that ways and means be found to make a direct statement of the way in which a test fuel matches reference fuels, thereby expressing the quality of test fuels in percentage of reference fuels.

STANDARDS SESSION

C. H. Stanard, *Chairman*

Based on long-term work of an important standardization group, the standards session was devoted to a single

paper and considerable prepared discussion on the engineering of involute splines.

***Engineering of Involute Splines*—G. L. McCAIN, Chrysler Corp.**

MR. McCAIN presented the engineering basis on which the recently adopted SAE standard on involute splines for general applications was formulated, and set forth the reasons for the wide use of this standard as an economical as well as engineering implement in the hands of automotive and general mechanical equipment manufacturers, and the suppliers of the tools, gages, and so on. He gave, in addition, the historical background of the project as a cooperative accomplishment with other groups, such as the gear, tool, and machine tool industries as represented in their national associations concerned with this type of activity.

Present standards for involute splines, he said, are based substantially on recommendations made in 1920. Referring to a paper by D. T. Hamilton (*SAE Journal*, August, 1920), Mr. McCain outlined the advantages of the involute spline as a connecting and driving mechanism . . . greater possibilities for securing interchangeability between parts, more accurate generation, tendency to keep the parts concentric with each other, so that decreased gear noise is experienced when it is used in an automobile transmission, and reduced number of standards necessary to cover all conditions.

Mr. McCain surveyed the mathematics involved in developing the details of the standard and the methods of producing and gaging the splines, and offered information for their selection and application.

The standard, based on the 1-2 ratio of diametral pitches, can be used as the basis for other dp ratios where the use of such special combinations may be required for particular reasons.

Complete standard and supplementary information and data on production tools, check gaging, and applications will be included in the 1946 edition of the SAE Handbook, now being compiled.

DISCUSSION

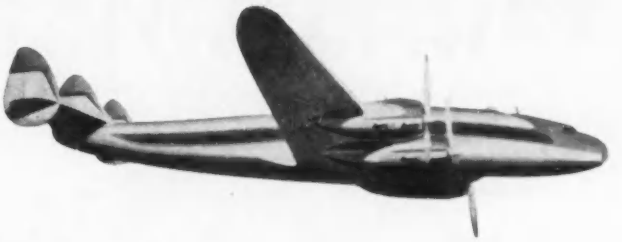
This involute spline standard has been based upon ease of manufacture, control of quality, and functional value, C. H. Stanard, Buick Motor Division, General Motors Corp., remarked. It is, he said, a spline system of first-class engineering design and functional qualifications, but has also been engineered for production.

Mr. Stanard then discussed the following factors that must be recognized and controlled in order that fitting qualifications can be met: tooth form, spacing, concentricity, lead, mounting, and fiber structure.

An example of how tooling costs can be minimized by adoption of the new spline standards was presented by H. H. Gotberg, Colonial Broach Co. The new standard is based on a stud tooth form, which reduces the required depth of broach cut, he explained, thereby reducing the overall length of broach as compared to the length of broach required for a full depth involute form.

The effect of interference errors on the tooth thickness of splines and spline gages was discussed by A. Beam, Vinco Corp. These errors, he said, are of four types: spacing, profile, alignment, and roundness, and have the effect of preventing splined shafts of a given tooth thickness from fitting splined holes of equal space width, as measured by means of pins.

Discussion of the advantages of the involute curve as compared with the single radius on spline broaches was given by S. O. Bjornberg, Illinois Tool Works. If a radius is to be substituted for an involute, he explained, the maximum free tolerance permitted in manufacturing is that remaining after the basic error between radius and involute is subtracted from the original profile tolerance. When no concession is granted to the radius profile, he concluded, it would seem that the handicap of operating with reduced tolerances should make much less attractive the apparent ease with which a radius can be substituted for an involute.



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5186 Navy Test Pilot, 29, 8 yrs. aero. design and flying experience, ME degree. Desires sales engrg., contact, dev. or test work. Will travel anywhere. Available immediately. Resident – Penn.

5188 Supt., Fleet Operations and Maint., 28, 5 yrs. experience Army Operations and Maint. Officer (475 vehicles), gasoline and diesel equipment. BS in ME. Resident – Montana, prefers West or Northwest location. Available Jan. 1, 1946.

5205 Sales or Service Promotion, grad. ME, 42, recently Captain Marines, desires connection with car, truck or parts manu. or major oil co. 20 yrs. experience. Location open, available immediately, resident – N. Y.

5216 M.E. Grad., M.I.T., 26, former Naval officer, experience toolmaker, has held CE and Prod. Mgr. positions in metal fabrication and assembly. Available immediately. Resident – N. Y., location open.

5217 Tool Process Engineer, 30, married, veteran Army Air Forces, physically fit, 10 yrs. wide practical experience tool and gage mfg. and inspection. Available immediately, temporary resident – Denver, Colo., prefers Detroit area.

5218 Industrial Engineer, General Foreman, Prod. Mgr. or Supt., 43, Army officer (Major), transferred to inactive duty, 20 yrs. experience in machine tool field, in handling and supervising personnel. Best of character. Available immediately. Resident – Va., location open.

5219 Production Engineer, 33, grad. EE, 7 yrs. experience supervising manu. prod. and inspection of automotive parts, 4 yrs. as project and liaison officer on tracklaying vehicles for Ordnance Dept. Resident – Mich., location open.

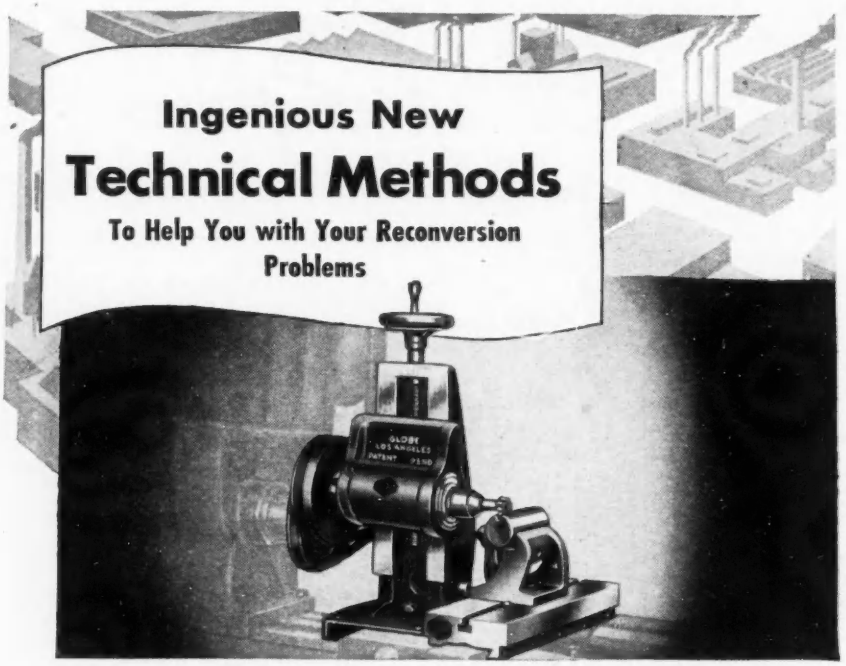
5220 Commercial Engineer, with Master's degree in Automotive Engrg. 30, 2 yrs. experience in automotive engrg., 4 yrs. as project officer, Capt. U. S. Army, on tank dev. Desires position as project or sales engineer in automotive or related field. Resident – Detroit, prefers Midwest or Southern location.

5242 Experimental Engineer, 34, 10 yrs. experience, now Major Ordnance Dept., desires supervisory position in automotive engine dev., sales engrg. or accessory fields. Available Jan. 1. Resident – Detroit, prefers Conn. or Detroit location.

5255 Mech. Engr., 25, BS Iowa State, 2½ yrs. experience testing performance of B-29 airplane, maint. test crew flight engineer and experience with maint. and overhaul of aircraft engines and allied equipment. Desires work in internal combustion engine testing or design. Resident – Iowa, prefers Midwest location, otherwise open.

5256 Research & Dev. Engr., 24, married, 6 yrs. varied experience in designing and dev. of diesel engines and accessories. Experience includes gas turbines and superchargers. Capable and experienced in project planning and supervision. Desires position with progressive firm. Resident – N. Y. C., prefers Met. N. Y. location.

5262 Mech. Engr., 23, former Air Corps Engrg. officer, 3 yrs. experience in design, plant and aircraft maint., shop processes, field work. Desires machine design, prod. dev. or plant maint. position. Resident – N. Y. C., prefers Met. N. Y. or New England location.



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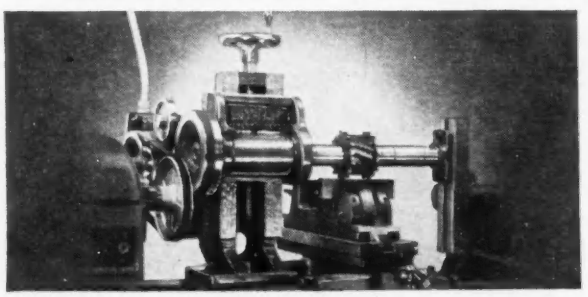

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5267 Grad. M.E., 23, veteran, on "Dean's List of Distinguished Students" for 4 yrs., speaks, reads, writes German fluently, 2 yrs. experience in assembly, repair, maint., operation of diesel and automotive equipment, desires research or experimental work. Resident – L. I., prefers eastern location.

5268 Mech. Engr., 35, Master's degree with 1 yr. experience in diesel fuel injection research; 6 yrs. experience as field engineer for prominent industrial consultant involving cost reduction programs in diversified industries through better methods, equipment, plant layout, etc.; served 4 yrs. as Captain, assigned to Office of Chief of Ordnance – Detroit, Dev. Div., as Project Engineer and carried through to completion 14 major vehicle dev. projects. To be released from Army Dec. 31, 1945. Desires responsible position in progressive co. as Industrial Engineer, Dev. Engr. or Sales Engineer. Resident – Mich., location open.

5271 Research and Test Engineer, Army officer, 27, available soon, BS ME and ME grad. courses, 5 yrs. engine experience. Possesses civilian and Army (Proving Ground Command) experience, initiative and interest in aircraft type reciprocating engine and gas turbine dev. and testing work. Presently in chg. of large and important Air Corps engine investigating program. Desires permanent, responsible position with co. doing reciprocating engine or gas turbine research, dev., etc. Prefers Detroit location, otherwise open. Resident – Fla.

5276 Mech. Engr., Lt. USNR, 24, available Jan. 15 after completing 18 mos. post-grad. design engrg. course at U. S. Naval Academy, 2 yrs. naval experience supv. ship construction and machinery repairs, 7 mos. in test dept. of truck and bus manu. Especially desires position with future in prod. and adm. while continuing education in industrial engrg. Resident – N. Y. C., prefers N. Y. C. location, otherwise open.

5279 Mech. Engr., 24, to be released from U. S. Navy, desirous of research in diesel engrg. or engrg. rep. in foreign countries (France, China). Good knowledge in French and Chinese. Schooled in diesel engrg. in Navy. Resident – N. Y. C., stationed in Colo., location open.

5285 Automotive Engr. Grad., M.I.T., 26, 4 yrs. experience in gasoline and diesel engines and gas turbine dev., research and service. Desires position in sales or sales-service. Available immediately. Resident – Mass., location open.

5287 Grad. Mech. Engr., 34, experienced in research and dev. in aircraft power plant and petroleum industries, desires position as executive engineer involving supv. and adm. of engrg. projects of an experimental character and in such capacity to direct the purchasing requirements and experimental investigations incident to the dev. Now serving as Lt. (s.g.) in U. S. Navy, to be released in Spring, 1946. Resident – N. J., stationed in Wash., D. C., location open.

5288 Automobile Engineer, 26, ex-British Army officer, married, experienced in development and research work, wishes to contact American co. with view

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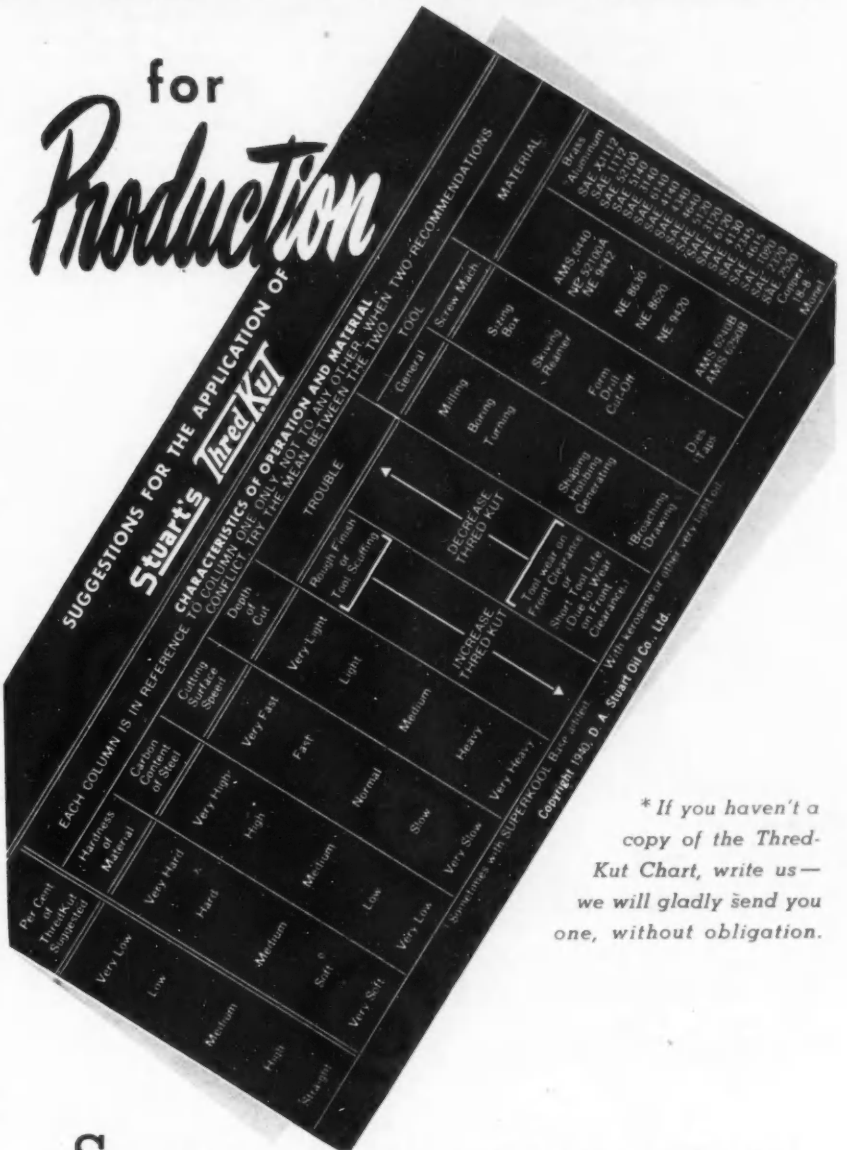

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5296 Young Grad M.E., 21, 1 yr. USMM, marine engrg. Desires machine design, prod. dev. or experimental work. Speaks fluent Spanish and French. Resident – N. Y. C., prefers Met. N. Y. or New England location.

5298 Mech. Engr., 26, 3 yrs. aircraft maint. officer in Air Corps. Experience in supv. of aircraft and accessory overhaul shops. Desires aircraft or engine overhaul and maint.; aircraft or other internal combustion dev. and prod. Resident – N. Y. C., prefers New York City location, otherwise open.

5299 Fleet Maint. & Serv. Supt., 37, wide experience large automotive fleet maint. A-1 at preventive maint. methods and cutting operational costs. Also qualify as serv. mgr. experience, selling service, flat rate and time study. Understands handling personnel, especially mechanics. Army Quartermaster – civilian automotive instructor, teaching principles and repairs; Navy – district automotive maint. officer. Adviser maint. procedures and problems, field inspector. Location open, resident – N. Y. C., available Feb., 1946.

5301 Mech. Engr., 25, 4 yrs. AAF and civilian supervisory experience in aircraft and engine maint. Prefers position involving research or project dev. Now in Army, will be out shortly. Resident – Chicago, prefers West or Midwest location.

5302 Executive: Auto and Transp., 40, married, grad. EE, inactive officer just completed 2 yrs. as Transp. Officer in China and 3 yrs. Chief Exec. Automotive Training School. Previous experience as executive engineer 6 yrs. design, test and application of automotive brakes and 4 yrs. design, test and application elect. equipment. Resident – Georgia, prefers southern location, otherwise open.

■ ■

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THE letters we receive asking about the VISCO-METER* would lead one to believe that all gasoline and Diesel engine designers, builders and operators came from the "show me" state. That's good...and as it should be.

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SAE Plastics Group Sees Tests at Ford

THE Plastics Glazing Committee, recently appointed by the SAE Technical Board to study the question of transparent plastics for glazing motor vehicles, witnessed a demonstration of the safety features of plastic glazings in tests conducted at the Ford River Rouge plant in connection with the Committee's Dec. 5 meeting.

R. H. McCarroll, Ford executive engineer, who is SAE Technical Board sponsor for the project, was host to the committee, many of whose members were present. Committee Chairman J. L. McCloud of Ford was master of ceremonies at the Rouge Plant tests. Cooperating were W. R. Koch of Wright Field and G. M. Kline, National Bureau of Standards.

In the tests, a leather bag filled with 12 lb of shot was swung from various heights against the plastic glazings, demonstrating the superior safety features of the plastic material. Slow motion pictures recorded the tests. At subsequent meetings, the committee will probe weather, temperature and scratch resistant qualities of plastic glazings as part of the study series.

Set up as a result of interest in the problem by motor vehicle manufacturers, state motor vehicle administrators and the Interstate Commerce Commission, which posed the question of egress from buses if the glazing tended to imprison passengers in case of a wreck, the committee consists of Mr. McCloud, chairman, and S. D. Douglas, Carbide and Carbon Chemical Corp.; Dr. N. N. T. Samaras, Monsanto Chemical Corp.; W. C. Goggin, Dow Chemical Co.; C. E. Heussner, Chrysler Corp.; D. A. Hurst, Rohm & Haas Co.; G. M. Kuettel, duPont Plastics Department; W. M. Phillips, General Motors Corp.; J. H. Sherts, Pittsburgh Plate Glass Co.; Theodore Ulrich, Nash-Kelvinator Corp.; R. E. Van Deventer, Packard Motor Car Co.; Frank Spring, Hudson Motor Car Co.; and P. W. Sullivan, Studebaker Corp.

The committee's report, when finally made, will channel through the SAE Technical Board to the American Standards Association for appropriate consideration.

APPLICATIONS Received

The applications for membership received between Dec. 10, 1945, and Jan. 10, 1946, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Buffalo Section: Roy R. Fruehauf, Cleveland L. Hildebrand, Walter G. Lautz, Albert L. Preston.

Canadian Section: James R. Clerke, Edward Douglas James, Joseph H. McCann, Maurice Henry McCurdy, Jack Archibald McMillan, Daniel Ivan McTavish, George Edward Otter, Thomas Donald Wallace, Albert Edward Weightman.

Chicago Section: W. L. Collins, Richard A. Peterson, William Albert Prickett, Norman D. Williams.

Cincinnati Section: George Black, Walter L. Broghamer, William R. Hummel, Paul J. Jung, William L. Suire, John Weber.

Cleveland Section: Alfred J. Chandler, Harold B. Finger, Ambrose Ginsburg, Harry S. Imming, Harry Kreizwald, Edwin H. Scott.

Dayton Section: Capt. James D. Hoffman.

Detroit Section: Frank T. Cox, Jr., Robert Owen Ellerby, Richard Freund, C. E. Greene, Russell E. Kaufman, Lawrence R. Lentz, Edward F. Mayne, Jr., Robert H. Pinney, Robert W. Ragen, James L. Roach, Claude Edward Schaefer, Daniel A. Sherick, Glenn D. Tooker, William W. Vesey, Jr., Donald M. Wheeler, E. P. Wise.

Hawaiian Section: Albert Colclough, Arthur C. Neely.

Indiana Section: Roy E. Adams, Melvin E. Estey, Emil C. Iverson, Wayne H. McGlade, Jack William Wackerbarth.

Kansas City Section: William W. Carter, Al Stratton.

Metropolitan Section: Edward Vernon Albert, William Richard Barry, William Jay deBoer, Wilmer R. Decker, Jr., Donald S. Kleckner, Don H. Holbrook, Alan A. Kurtis, Robert B. Lane, Joseph V. Montuori, Henry Muller, Frank A. Pallone, Elliot Schiller, Sam Seckler, Thomas A. Simpson, Donald Frederick Suppes.

Mid-Continent Section: Ed Renier.

Mohawk-Hudson Group: George R. Fusner, Osmon A. Tilton.

New England Section: Carl H. Thurston.

Northern California Section: Wilbur Herbert Ball, Lt. James W. McGuffey, Walter W. Parkhill, J. M. Plantfeber, Lt.-Col. Walter W. Woodard.

Northwest Section: John Conti, John E. Hanson, Jr., Robert R. Mead, Walter LeRoy Perry, Michael Edward Solkey.

Oregon Section: Gar S. Hastings.

Peoria Section: Burton Rich Miller Victor Z. Pavlenko.

Philadelphia Section: James H. M. Boas, Joseph Brennian, Jr., Lewis Alden Estes, Francis H. Gibson, William Clinton Hale, Jr., Arthur N. Holroyd, Wilber B. Reed, Clifford J. Ulzheimer.

Pittsburgh Section: Cpl. Lawrence C. Armstrong, Jr., W. Orland Lytle.

St. Louis Section: Wesley A. Harper.

Southern California Section: Capt. Seward H. Allen, Michael Ambroff, Russell S. Barr, Burton A. Chalmers, Bruce E. Dixson, Charles A. Dow, Bert Folda, Fred L. Johnson, Lt. Allan L. Jones, Robert V. Lindberg, John O. Longenecker, Bo Klas Oskar Lundberg, Eugene F. May, Herbert C. Noll,

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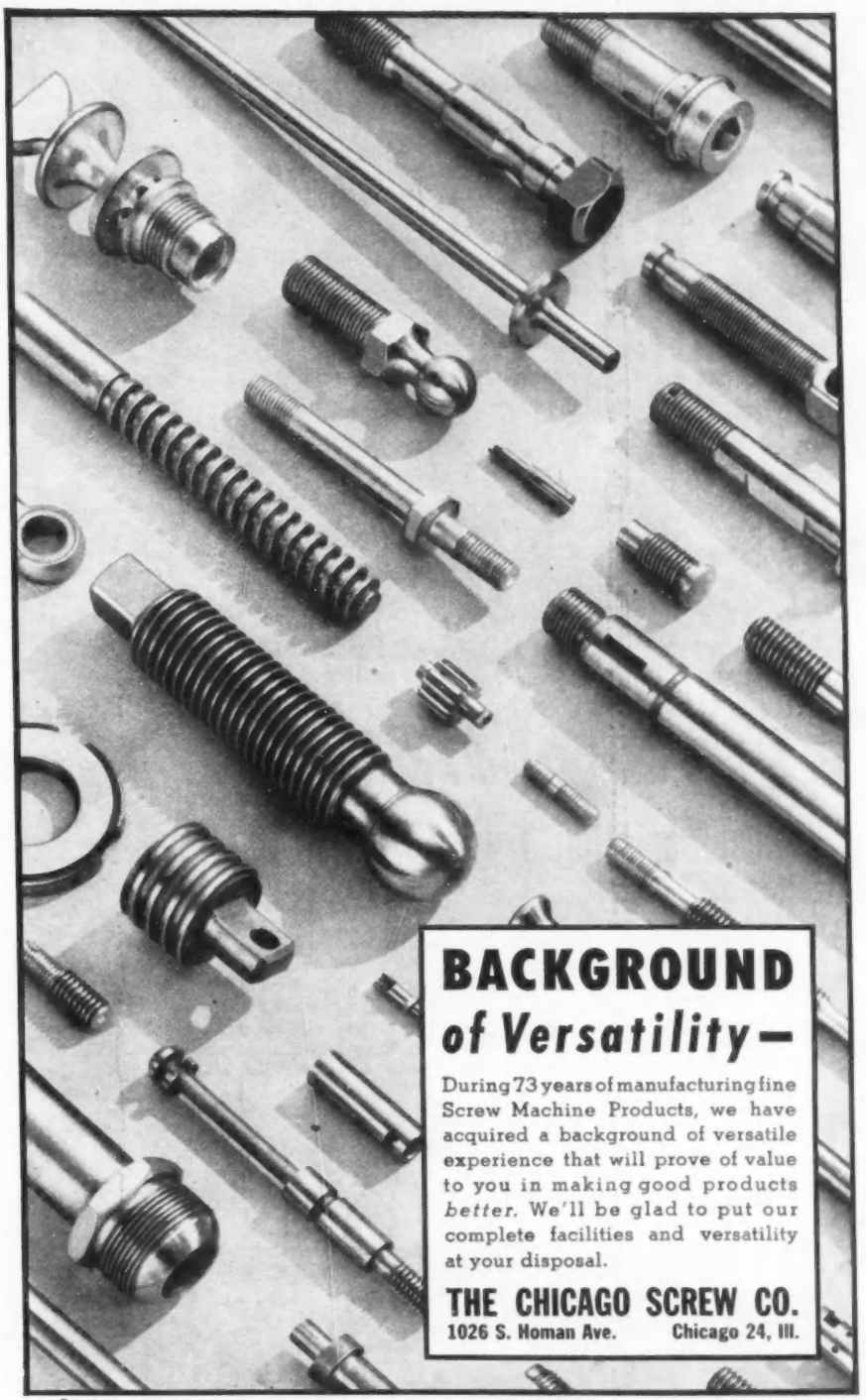
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NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 10, 1945, and Jan 10, 1946.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Buffalo Section: James L. Webb, Jr. (J).

Canadian Section: James M. Law (A).

Chicago Section: Robert E. Burnison (A), George A. Ellis (M), Ray L. Howard (M), Alfred F. Jaeschke (A), James DeLoss Johnson (J), Lt.-Col. T. K. Lewis (SM), Robert D. McIntosh (M), Carroll V. Wells (M), Walter R. Zaleski (J).

Cincinnati Section: Clifford Walter Packer (J).

Cleveland Section: William Dabney Bowman (J), Miles William Detling (J), Eugene D. Funk (A), Ben. F. Jones (J), Robert M. Markley (A), Earl J. Senne (A), Solomon M. Sorin (J).

Colorado Group: Edward L. Cody (A).

Dayton Section: Capt. Ralph J. Eschborn (J), Robert LeRoy Lennon (J)

Detroit Section: Robert B. Batchelor (J), Cecil C. Buckner (M), John J. Bush (M), Lt. C. V. Gardiner (J), Edward T. Hopkins (A), William Francis Knouff (M), Hazen H. Kraus (M), Clarence L. Mellor, Jr. (A), Peter J. Miller (M), S. S. Pierce (M), Arthur G. Reiser (M), Alvin B. Richards (M), Leon C. Shuert (M), Lawrence H. Skromme (M), Bruce K. Tice (M), Robert William Wright (SM).

Hawaiian Section: Irving W. Murray (A).

Indiana Section: Melvin Nelson Osborn (J), Paul C. Zmola (J).

Metropolitan Section: Robert D. Barry (M), Selig J. Bernstein (J), Gordon D. Brown (A), Richard L. Charlesworth (J), Herbert W. Fingerhut (M), John T. Fisher (M), Heinz Hanau (J), Louis Heimbinder (A), Morton Pomeroy Matthew (M), Orest A. Meykar (M), Charles Henry Pettis (J), David W. Rice (J), James M. Sherilla (A), Albert A. Smith, Jr. (M), J. M. Van Law (M), Claude I. Zabriskie (A).

Mid-Continent Section: Carl R. Bartholomew (A).

New England Section: Lt. (jg) Earl E. Andrews (J), Major Charles F. Peters (SM), R. Douglas Smith (J), Edgar D. Yule (A).

Northern California Section: Beecher Avakian (A), Capt. Rolund Frank DeHoog (J), David Feld (J), Earl J. Hesse (A), Elvin B. Lien (M), Ray Thomas Olson (A), Major Joseph N. Raymond (J), Henry Carl Witt (J).

Northwest Section: Ed. Short (A).

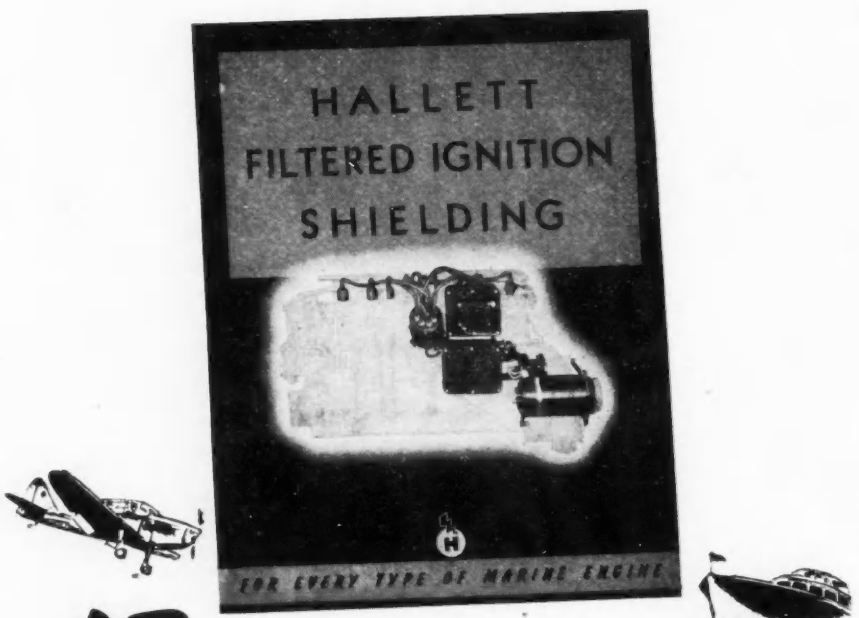
Oregon Section: Hugh Matthew Small (J).

Philadelphia Section: Nicholas Thomas Karaffa (J), Frank Kenney (A), Frank A. Vossenberg (M).

Pittsburgh Section: Bernard A. Bannon, Jr. (A), James Richard Keefner (A).

Salt Lake Group: Clyde E. Ockey (M).

Southern California Section: Arnold N. Anderson (M), Paul Richard Belanger (J), John C. Bloom (J), Robert J. Considine (J), Gilbert Lemar Hitchcock (A), E. G. Hutchinson (A), Joseph F. MacCaughtry (A), Raymond H. Osbrink (M), Dan R. Rankin (M), James H. Richards (M), Philip L. Sullivan (A), Wilbur James Wells (A), Hull M. Wickham (J), Lynn J. Ziegelmeyer (A).



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Spokane Group: August Stevens Matresse (A).

Twin City Group: LeRoy Alexander Griffith (M), A. P. Upton (M).

Virginia Group: Kinney Lee Jones (M); Paul R. Lauritzen (A), A. L. Lawrence (A), C. A. Moore (A), Curry Obenshain (M), Emmett L. Perkins, Jr. (A), Thomas C. Utterback (A), Benjamin Franklin Watkins (M).

Washington Section: Don Caffery Glassie (A), Lt. (AE) (P) John Philipp Milford Reid (J), Bernard J. Vierling (M).

Wichita Section: H. A. Mayor (M).

Outside of Section Territory: E. C. Aldridge (M), Harry C. Archer (J), John V. Kalb (J), Eric R. Miller (SM), Abner L. Mims, Jr. (J), William Earl Moody (A), Edwin William Niemi (J), Thomas Joseph O'Toole (J), Warren Henry Rogerson (A), J. D. Sutton (A), Franklin Harbaugh Swenson (J), Herbert Hiram Thurston (M).

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Spokane Group: Homer L. Rouse.

Syracuse Section: Claude M. Bigelow, James E. Midkiff, Alexander E. Weaver.

Texas Section: Robert Stephens Belfry, Herbert A. Helstrom, Jr.

Washington Section: Chester Lawrence Belding, Lt. Joseph Van Vechten Boss, Jr., Kenneth Phillip Forman, Edward L. Hollady, A. Edward McGarry.

Western Michigan Section: William F. Hayes, Lily Gertrude Short.

Outside of Section Territory: T. W. Culmer, William John Lloyd, Walter E. Schirmer, Edgar F. Speiden, Philip Hubert Walker, Ralph S. Wilson.

Foreign: Col. Richard Thomas Barr, England; Miquel Erique Guermont, England; Gustaf Gundmundson, Sweden; Arthur Shepherd Hukin, England; George Bernard Jones, England; Albert Edward Palmer, England; Julie Trinchero, Brazil; Edward Turner, England; Bengt Welin, Sweden.

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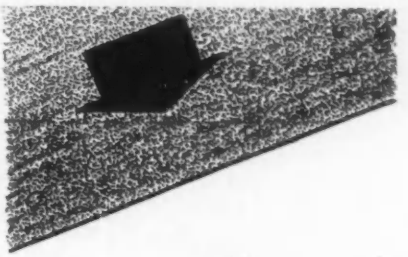

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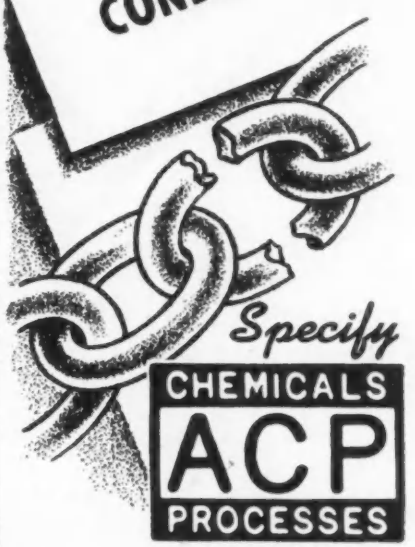

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colonel in the USAAF. He was formerly serving at headquarters of the Far East Air Forces.

After serving since January, 1941, in the U. S. Army, **HARRY A. BIGLEY, JR.**, has returned to the Gulf Research & Development Co., Pittsburgh, as automotive road test engineer. Mr. Bigley served as a captain at Camp Hulen, Tex.

SAMUEL F. ROLPH has been named vice-president and general manager of Connector Locks of America, Inc., Detroit. He was formerly sales manager, automotive products, Yale & Towne Mfg. Co., same city.

Previously field representative, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn., **JAMES W. McKERCHER** is now serving in a similar position with United Aircraft Service Corp., a subsidiary of United Aircraft Corp.

CARROLL I. HENWOOD, JR., formerly powerplant engineer, flight test engineering section, Transcontinental & Western Air, Inc., Kansas City, Mo., is now a sales-application engineer with the Minneapolis-Honeywell Regulator Co., San Francisco.

CLINTON L. WEBER is now a quality engineer with the Kelley-Koett Mfg. Co., Covington, Ky. He was previously a project engineer in the development section of Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

ERROL J. GAY, motor fuel and automotive technician with the Ethyl Corp. and technical consultant to the War Department in this field, has been awarded the Exceptional Civilian Service Award. Mr. Gay received the highest decoration given civilians by the War Department in recognition of his contribution to the Army Service Forces in "standardizing petroleum products and containers for overseas operations."

CARL R. HENNICKE has severed his connection as chief engineer of the Eberhard Mfg. Co., Cleveland, to join the United Mfg. Co. of Bedford, Ohio, where he will be serving in a similar capacity.

Formerly manager of the Motor Transport Marketing Division, Pure Oil Co., Chicago, **WILLIAM G. SCRANTOM** is now operations manager of the Seaboard Oil Co., Jacksonville, Fla.

Previously experimental test engineer, Allison Division, General Motors Corp., Plant No. 2, Indianapolis, Ind., **WILLIAM M. CARPENTER** has now joined Hercules Motors, Canton, Ohio, as a layout designer.

MARTIN J. NEUMEYER has recently joined Warner Aircraft Corp., Detroit, as an hydraulic test engineer. He was formerly a mechanical engineer with General Motors Overseas Operations, New York City.

WALTER M. NEAL has joined the C. M. Fuller Co., Los Angeles, Calif., as a sales engineer. He was formerly manager of the automotive maintenance department, Lockheed Aircraft Corp., Burbank.

Formerly field representative, United Aircraft Corp., East Hartford, Conn., **LOYD E. NEIL** is now assistant superintendent of maintenance for Northeast Airlines, Inc., East Boston, Mass.

LLOYD J. WOLF is now an automotive engineer serving on the Armored Board at Fort Knox, Ky. Previous to this, he was a test engineer with the Detroit Transmission Division of General Motors Corp.

Formerly a tool engineer with Continental Motors Corp., Dallas, Tex., **B. F. ZEIGLER, JR.**, has recently become production engineer in charge of production and engineering, Vulcan Bearing Machine Co., same city.

ARTHUR A. WOODWARD, who had been with the U. S. Army, Transport Corps, stock control section, Washington, is now associated with the Prince Georges Development Corp., Bladensberg, Md., in an engineering capacity.

Formerly assistant manager of the Indiana Power Division, International Harvester Co., **N. O. PANZEGRAU** is now an engineering consultant on foreign operations for the same firm with offices in Chicago.

C. M. MYERS, who formerly served as sales representative with Mack International Motor Truck Corp., Albany, N. Y., is now a salesman in the Truck Division of the Albany Garage Co.

DAVID L. PENN is now assistant mechanical engineer, Department of Water & Power, city of Los Angeles, Calif. He was formerly process engineer, Lockheed Aircraft Corp., Burbank, Calif.

Formerly executive engineer, Cummins Perforator Co., Chicago, **GLEN E. WIM-**

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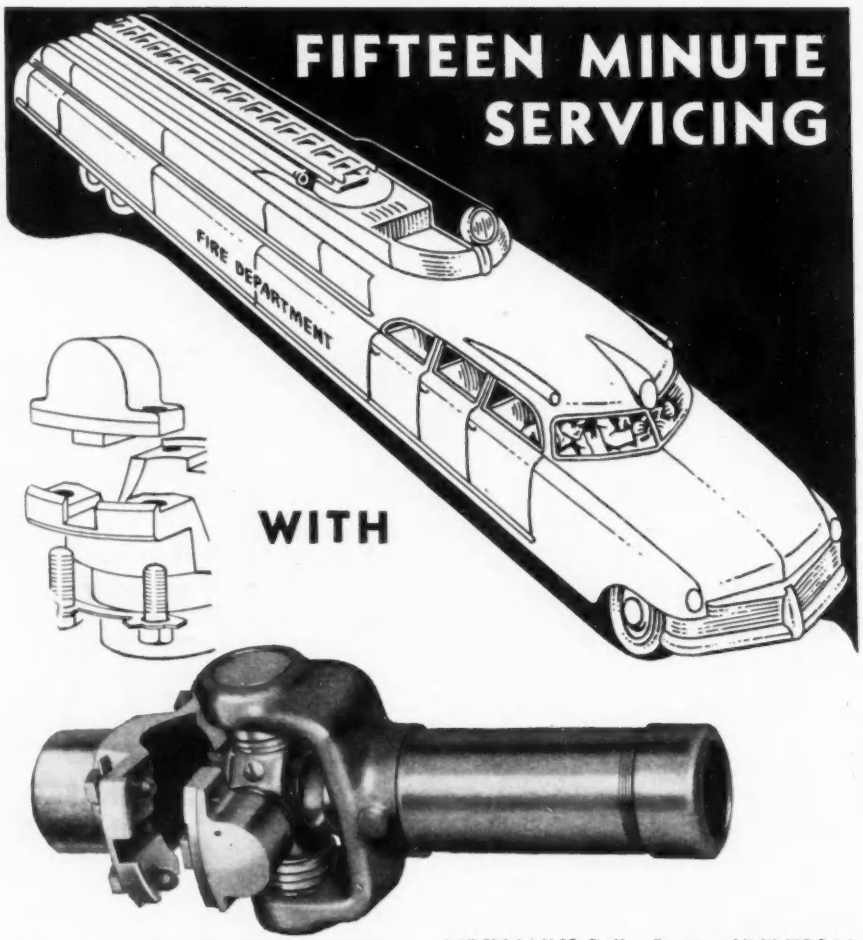

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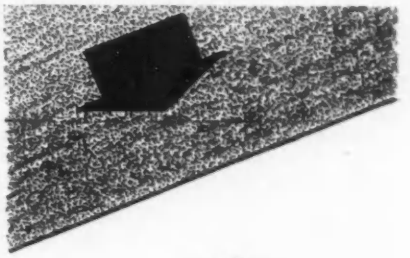

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AMBLER ACP PENNA.

colonel in the USAAF. He was formerly serving at headquarters of the Far East Air Forces.

After serving since January, 1941, in the U. S. Army, **HARRY A. BIGLEY, JR.**, has returned to the Gulf Research & Development Co., Pittsburgh, as automotive road test engineer. Mr. Bigley served as a captain at Camp Hulen, Tex.

SAMUEL F. ROLPH has been named vice-president and general manager of Connector Locks of America, Inc., Detroit. He was formerly sales manager, automotive products, Yale & Towne Mfg. Co., same city.

Previously field representative, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn., **JAMES W. McKERCHER** is now serving in a similar position with United Aircraft Service Corp., a subsidiary of United Aircraft Corp.

CARROLL I. HENWOOD, JR., formerly powerplant engineer, flight test engineering section, Transcontinental & Western Air, Inc., Kansas City, Mo., is now a sales-application engineer with the Minneapolis-Honeywell Regulator Co., San Francisco.

CLINTON L. WEBER is now a quality engineer with the Kelley-Koett Mfg. Co., Covington, Ky. He was previously a project engineer in the development section of Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

ERROL J. GAY, motor fuel and automotive technician with the Ethyl Corp. and technical consultant to the War Department in this field, has been awarded the Exceptional Civilian Service Award. Mr. Gay received the highest decoration given civilians by the War Department in recognition of his contribution to the Army Service Forces in "standardizing petroleum products and containers for overseas operations."

CARL R. HENNICKE has severed his connection as chief engineer of the Eberhard Mfg. Co., Cleveland, to join the United Mfg. Co. of Bedford, Ohio, where he will be serving in a similar capacity.

Formerly manager of the Motor Transport Marketing Division, Pure Oil Co., Chicago, **WILLIAM G. SCRANTOM** is now operations manager of the Seaboard Oil Co., Jacksonville, Fla.

Previously experimental test engineer, Allison Division, General Motors Corp., Plant No. 2, Indianapolis, Ind., **WILLIAM M. CARPENTER** has now joined Hercules Motors, Canton, Ohio, as a layout designer.

MARTIN J. NEUMEYER has recently joined Warner Aircraft Corp., Detroit, as an hydraulic test engineer. He was formerly a mechanical engineer with General Motors Overseas Operations, New York City.

WALTER M. NEAL has joined the C. M. Fuller Co., Los Angeles, Calif., as a sales engineer. He was formerly manager of the automotive maintenance department, Lockheed Aircraft Corp., Burbank.

Formerly field representative, United Aircraft Corp., East Hartford, Conn., **LOYD E. NEIL** is now assistant superintendent of maintenance for Northeast Airlines, Inc., East Boston, Mass.

LLOYD J. WOLF is now an automotive engineer serving on the Armored Board at Fort Knox, Ky. Previous to this, he was a test engineer with the Detroit Transmission Division of General Motors Corp.

Formerly a tool engineer with Continental Motors Corp., Dallas, Tex., **B. F. ZEIGLER, JR.**, has recently become production engineer in charge of production and engineering, Vulcan Bearing Machine Co., same city.

ARTHUR A. WOODWARD, who had been with the U. S. Army, Transport Corps, stock control section, Washington, is now associated with the Prince Georges Development Corp., Bladensberg, Md., in an engineering capacity.

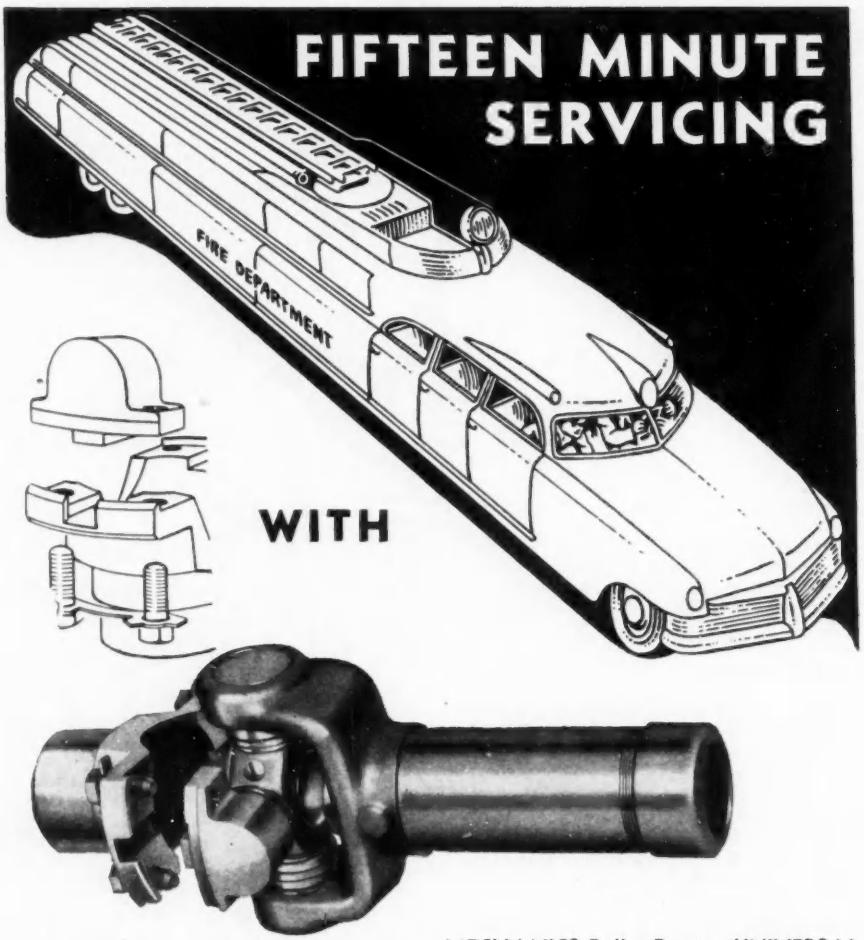
Formerly assistant manager of the Indiana Power Division, International Harvester Co., **N. O. PANZEGRAU** is now an engineering consultant on foreign operations for the same firm with offices in Chicago.

C. M. MYERS, who formerly served as sales representative with Mack International Motor Truck Corp., Albany, N. Y., is now a salesman in the Truck Division of the Albany Garage Co.

DAVID L. PENN is now assistant mechanical engineer, Department of Water & Power, city of Los Angeles, Calif. He was formerly process engineer, Lockheed Aircraft Corp., Burbank, Calif.

Formerly executive engineer, Cummins Perforator Co., Chicago, **GLEN E. WIM-**

turn to p. 79



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MER is now a project engineer with Tammen & Denison, Inc., same city.

EDWIN C. PICKARD has joined Chevrolet Light Car Division, General Motors Corp., Detroit, as trim engineer. He was formerly assistant to the executive engineer of Packard Motor Car Co.

Until recently principal automotive specialist on tools, St. Louis Ordnance Depot, Office of the Chief of Ordnance, St. Louis, Mo., D. C. WHITE is now a salesman with the Sunnen Products Co., same city.

NATHAN C. PRICE has been named director of powerplant engineering of the Menasco Mfg. Co., Burbank, Calif. He was formerly engine development engineer with Lockheed Aircraft Corp., same city.

Formerly field service engineer, AC Spark Plug Division, General Motors Corp., Flint, Mich., WILLIAM H. RAGSDALE is now project engineer in the experimental department of GM Truck & Coach Division, Pontiac, Mich.

Formerly design group engineer, Aireseach Mfg. Co., Los Angeles, ORVILLE L. WILKINSON is now associated with the Hydro-Aire Co. as a design engineer.

KURT H. WEIL has been named technical adviser to the president of the International Development Co., New York City. Mr. Weil was previously in the Eastern Aircraft Division of General Motors Corp., Linden, N. J.

HUGH POPE is now associated with the Frazer & Jones Co. of Syracuse, N. Y. He was formerly manager of malleable iron sales, National Malleable & Steel Castings Co., Cicero, Ill.

Formerly assistant manager, lubricating sales department, Imperial Oil, Ltd., Toronto, Ont., Canada, A. G. SCOTT has been transferred to the British Columbia division of the firm where he is serving as sales manager.

WILLIAM W. HENNING is now engineer in charge of crawler tractors of the International Harvester Co., Chicago, Ill. He was formerly engineer in charge of design analysis for the same company.

A student member at the Lawrence Institute of Technology, Detroit, ALEXANDER MARDERIAN is now a junior draftsman with the Murray Corp. of America. He was formerly an inspector with the Ex-Cell-O Corp.

IRVING WEINBERG, formerly a student member at the University of Wisconsin, Madison, Wis., is now assistant plant engineer, Vilter Mfg. Co., Milwaukee, Wis.

EDWARD SHARP is now a teacher of industrial arts at Bishop Union Elementary School, Bishop, Calif. He had been machinery planner, Consolidated Steel Corp., Wilmington, Calif.

MAJOR MURTEN G. HIETT, Ordnance Department, has been transferred to the Fourth Service Command Reclamation Center, Atlanta, Ga., where he is chief of the automotive section. Major Hiett was formerly shops officer, Sixth Service Command Base Shop, Chicago.

WALTER D. APPEL, General Motors Overseas Operations, is now at Room 1703, General Motors Building, New York City.

RICHARD A. BAY is now specification engineer with the Pines Engineering Co., Aurora, Ill. Previously he was material specification engineer with the Western Condenser Co., Watseka, Ill.

Formerly supervisor, tool design department, Watervliet Arsenal, Watervliet, N. Y., CHARLES Z. SMITH, SR., is now a mechanical engineer with the Behr-Manning Corp., same city.

HUDSON T. MORTON has recently joined the Fafnir Bearing Co., New Britain, Conn., as a standards engineer. He was formerly sales engineer for the Hoover Ball & Bearing Co., Ann Arbor, Mich.

JAMES H. CLARK, JR., is now a project engineer with the Ford Motor Co., Dearborn, Mich. He formerly served as a designer with Packard Motor Car Co., Detroit.

H. L. McCORMICK, who had formerly been chief engineer of L.G.S. Spring Clutch Corp., Indianapolis, Ind., is now a consulting engineer with offices in Carmel, Ind.

P. H. PARKS has recently become affiliated with Continental Motors Corp., Muskegon, Mich., as an engineer in the export engineering department.

LEWIS E. MICHAEL, U. S. Army, is now an associate materials engineer serving with the Army Air Technical Service Command, Wright Field, Dayton, Ohio. He was

ENGINEERED *WEAR COMPENSATION*
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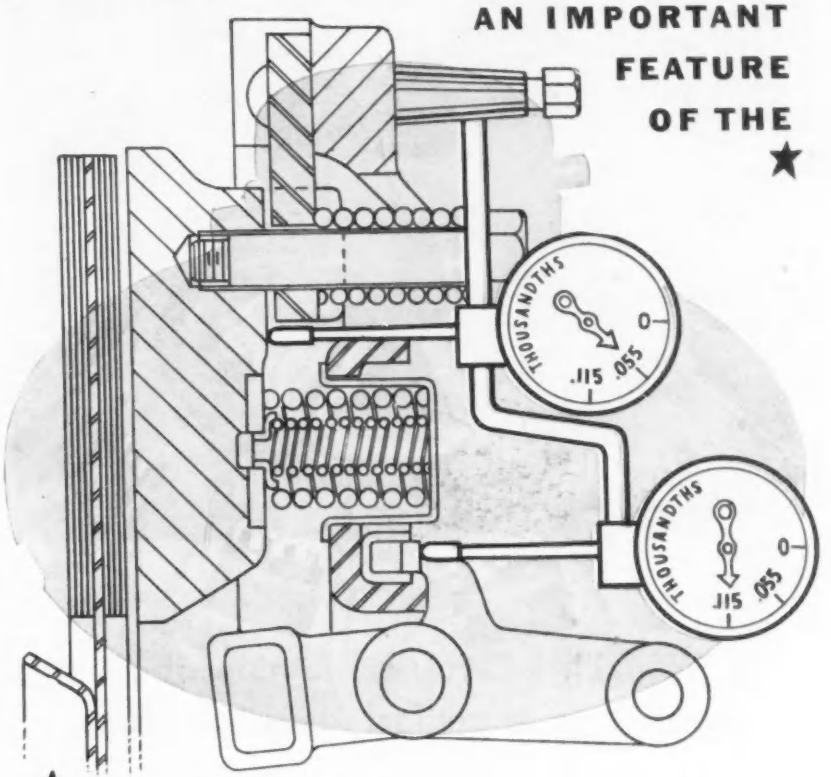

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WALLACE LINVILLE is now the owner of the Acelin Co. of Los Angeles, Calif. The firm specializes in the production of automobile tune-up and testing equipment.

Formerly layout draftsman, Continental Motors Corp., Muskegon, Mich., **GERRIT STEENHAGEN** is now associated with the Gray Marine Motor Co., Detroit.

F. T. STERLING, JR., is now an airline pilot with Pan American-Grace Airways, Inc., Lima, Peru. He was formerly with the same firm in Miami Springs, Fla.

OBITUARIES

C. A. Musselman

C. A. Musselman, chairman of the board of the Chilton Co., Philadelphia, died recently after a long illness. He was 73 years old.

Originally secretary and treasurer of the Chilton Co., he became president of its automotive publications unit in 1923. In 1934 he was elected president of the company and retired from that position in 1945 to become chairman of the board. Before joining Chilton, he was vice-president of the American Steel Export Co., New York City, exporters of steel, automobiles, and parts and accessories.

Elmer F. Brunner

Elmer F. Brunner, manager of farm tire development for the Goodyear Tire & Rubber Co., Akron, Ohio, died Jan. 5 in Cleveland following an operation.

Credited with having played a major role in putting rubber tires on mechanical farm equipment, Mr. Brunner also contributed to the success of some of the first tests made in the early 1930's on Goodyear airplane airwheel tires used on steel-wheeled tractors. He was placed in charge of Goodyear's farm tire development department in 1935. During World War II, he served as a consultant to the Office of the Rubber Director, WPB.

Active in SAE committee work, Mr. Brunner was membership chairman of the SAE Tractor & Farm Machinery Engineering Activity for 1945 and also served on the SAE Tractor War Emergency Committee.

Clarence L. Taylor

Clarence L. Taylor, vice-president in charge of engineering, Arms-Franklin Corp., Youngstown, Ohio, died recently at the age of 96.

Mr. Taylor began his engineering career about 1887 when he joined the Morgan Engineering Co., Alliance, Ohio. He remained with the company for 32 years, serving as chief engineer for 20 years. After leaving Morgan, he became vice-president in charge of engineering for the Aetna-Standard Engineering Co., Warren, Ohio. He was appointed a vice-president of the Arms-Franklin Corp. early in 1941.

Roy G. Beh

Roy G. Beh was fatally shot Dec. 21 by a hitch-hiker. Mr. Beh, mid-western representative, Breeze Corporations, Inc., Newark, N. J., was 34 years old.

Mr. Beh joined the Breeze organization in 1932, and advanced through the shop, laboratory and engineering departments to mid-western representative for the service engineering and sales department. He attended Colgate Univ., Hamilton, N. Y.

L. T. Carter

L. T. Carter, transportation engineer, General Electric Co., New York City, died recently at the age of 67.

Since 1904, Mr. Carter had been affiliated with the General Electric Co. As an engineer in charge of field engineers and inspectors, his work covered the development and operation of all types of transportation equipment. Prior to that he served as a field engineer assisting in the layout of car and locomotive equipment. He was graduated from Syracuse University in 1904.

Kenneth E. Mulvany

Kenneth E. Mulvany, assistant engineer in the Clark Tructractor division of the Clark Equipment Co., Battle Creek, Mich., died recently at the age of 41.

Mr. Mulvany attended Tri-State College from which he received a degree of B. S. in M. E. in 1930. He joined the Clark Equipment Co. in 1935 as a tool designer. In 1937 he left to assume a similar position with the Nash Motor Car Co., Racine, Wis. Since 1938 he has been assistant engineer.

You design automobiles, mister?

Well, I'll tell you something about this car. You've neglected the gas tank.

Sure, everyone used to neglect the gas tank. I know. But now the gas tank has been improved — on some cars.

Look, when a car equipped with VENTALARM drives in, I stick the gun into the filler neck, open the gun wide open. The VENTALARM whistle sounds. When it stops, I stop filling.

No uncertainty. No delay. No spills. No dribbling the gas in. I can fill two cars — equipped with VENTALARM — in the time it takes to fill this car.

VENTALARM installed in association with sub-surface fill saves 1% of the gasoline — speeds filling — establishes a safety zone within the tank — eliminates blowbacks — lessens fire hazard.

Two more manufacturers have added VENTALARM as standard equipment in the last two months — bringing the makes of cars, trucks, and buses now standard equipped with VENTALARM to twelve.

SCULLY
VENTALARM *The Whistling* **GAS TANK SIGNAL**
Household fuel tank type VENTALARM now assures safe automatic filling in 400,000 homes.
SCULLY SIGNAL COMPANY, 88 FIRST ST., CAMBRIDGE 41, MASSACHUSETTS

ELWIN F. **LINDSLEY** is now associate editor of *Scientific American*, New York City. He was formerly senior technical writer, Wright Aeronautical Corp., Paterson, N. J.

Previously resident engineer, Chrysler Corp., DeSoto Division, Detroit, **JOHN V. PRESTINI** recently joined the Budd Wheel Co. as a sales engineer.

Formerly an installation engineer, **W. C. PENZEL** is now a project engineer with the Allison Division of General Motors Corp. in the installation engineering section.

Previously shop supervisor, transportation department, Quonset Naval Air Station, Quonset, R. I., **EARLE C. WILLIAMS** is now an automotive machinist with Pacific Greyhound Lines, San Francisco.

BENJAMIN B. duPONT, formerly a test engineer on single-cylinder engines at Ranger Aircraft Engines, Farmingdale, L. I., N. Y., has left this company to resume his studies at Yale University, New Haven, Conn.

Formerly research and development engineer with Thompson Products, Inc., Cleveland, **LOUIS F. FISHER** is now associated with the Kelsey-Hayes Wheel Co. of Detroit.

Formerly a project engineer, U. S. Naval Ordnance, Center Line, Mich., **G. O. GOLLER** is now senior body designer with Chevrolet Motor Division, General Motors Corp., Detroit.

Formerly strength test engineer, Douglas Aircraft Co., Inc., Long Beach, Calif., **FRANK T. COLLINS** is now a structural designer with Van Alstine & McLean, same city.

ALBERT E. HOPE has been appointed general manager and a director of Anglamol, Ltd., London, England. He was previously petroleum technologist with Shell Mex and B. P., Ltd.

Formerly manager of the Lubricating Division of the American Oil & Supply Co., Newark, N. J., **TRACY LANGDON** is now the owner of his own firm, a complete machine tool lubrication service.

N. E. FARLEY, JR., formerly research engineer, Willys-Overland Motors, Inc., Toledo, is now a project engineer in the research experimental department of Kaiser-Frazer Corp., Ypsilanti, Mich.

FOSTER M. GRUBER has resigned from his position as production engineer with Douglas Aircraft Co., Inc., Santa Monica, Calif., to become administrative assistant to the president of Ellinwood Industries, Los Angeles.

FRANK A. DONALDSON, JR., has been appointed a vice-president of the Donaldson Co., Inc., St. Paul, Minn. Mr. Donaldson, who has recently been discharged from the USNR, had been a project engineer with the firm before leaving to join the Navy.

THOMAS J. KIELY has been named assistant to the vice-president of engineering of the American Bosch Corp., Springfield, Mass. Formerly Mr. Kiely was manager of aviation ignition field engineering for the same firm.

Formerly serving in the Baltimore, Md., branch of Revere Copper & Brass, Inc., **MARCUS A. WHITEHEAD** is now assistant sales manager of the Chicago branch of the same company.

Formerly a technical observer with the U. S. Army Field Forces, stationed at the Cummins Engine Co., Salt Lake City, Utah, **PAUL PHILLIPS** is now shop superintendent with Cummins Service & Sales of Los Angeles, Calif.

Formerly at the powerplant laboratory, USAAF, Wright Field, Dayton, Ohio, **DE OWEN NICHOLS, JR.,** is now senior engineer in the Research Division of General Motors Corp., Detroit, Mich.

G. A. GEMMER has been elected president and general manager of the Gemmer Chassis Corp., Richmond, Ind. He was formerly manager of the conversion department of the Wickett Motor Service Corp., same city.

Previously a project engineer with the Guiberson Diesel Engine Co., Dallas, Tex., **C. HUBERT SMITHSON** is now associated with the Moore Equipment Co., Stockton, Calif.

EARL J. HOYT, Skagit Steel & Iron Works, has been appointed production manager of the plant at Sedro-Wolley, Wash. He was formerly manager of the Seattle branch of the same firm.

Formerly works manager of the Supercharger Works, Allis-Chalmers Mfg. Co., Milwaukee, Wis., **ARNOLD RISTOW** is now serving in a similar capacity in the Electric Control Plant of the same company.

L. E. BAQUERIZO has recently become plant superintendent of Empresa Electrica del Ecuador, Guayaquil, Ecuador.

RICHARD B. KROPF has recently resigned his position as district manager in New England of the Copperweld Steel Co., and has joined the International Nickel Co., Inc., as a metallurgist in charge of the Cincinnati technical section of the Development and Research Division.

Formerly a student member at the University of Colorado, **D. E. McFERON,** an ensign in the USNR, is now stationed aboard the USS Crenshaw and may be contacted c/o Fleet Post Office, San Francisco.

JOHN C. SQUIERS has recently become a partner in the firm of Kelly, Soellner & Squiers, Inc., Detroit. He was formerly assistant chief engineer in the Airplane Parts Division of Briggs Mfg. Co., same city.

MATTHEW LAWMAN, JR., is now associated with the Reynolds Metals Co., Richmond, Va., as a design engineer.

WILLIAM P. ROBINSON, who had been a project engineer with the Packard Motor Car Co., Aircraft Engine Division, Toledo, Ohio, has joined the Bell Aircraft Corp., Helicopter Research Division, Niagara Falls, N. Y., as a transmission engineer.

R. WARREN LAHNERS has recently become a powerplant engineer with Transcontinental & Western Air, Inc., Kansas City, Mo. He was formerly liaison engineer with Wright Aeronautical Corp., Cincinnati.

Formerly tool engineer with Continental Motors Corp., Detroit, **DELMAR E. AHRENS** is now serving in a similar position with the Colonial Broach Co., same city.

JAMES B. OSLER, formerly managing director, Express Motor & Body Works, Ltd., Enfield, Middlesex, England, is now associated with Garlick, Burrell & Edwards, Ltd., Liverpool.

HARRY D. GOLDSTEIN is now a structures engineer with Lockheed Aircraft Corp., Burbank, Calif. He was previously with Curtiss-Wright Corp., Plant No. 2, Buffalo, N. Y., where he served in a similar capacity.

WALTER J. EWBANK has been named chief research engineer of the Briggs Filtration Co., Bethesda, Md. He was formerly chief engineer with the Briggs Clarifier Co., Washington.

LOUIS A. EDELMAN, first lieutenant, USAAF, has been transferred from Ardmore Army Air Field, Ardmore, Okla., to Marshall Field, Fort Riley, Kans., where he is supervisor of technical training.

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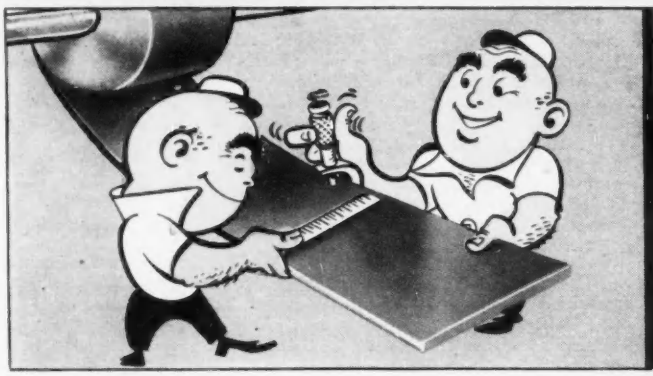
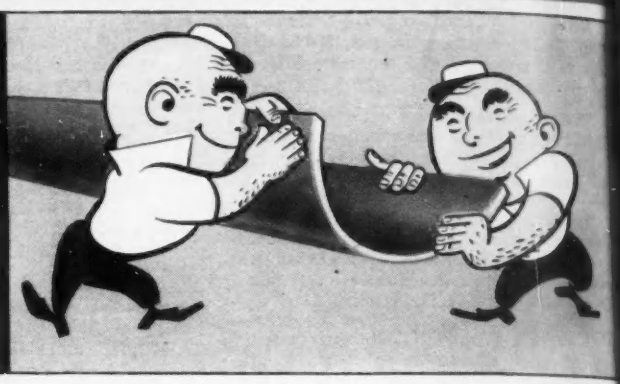
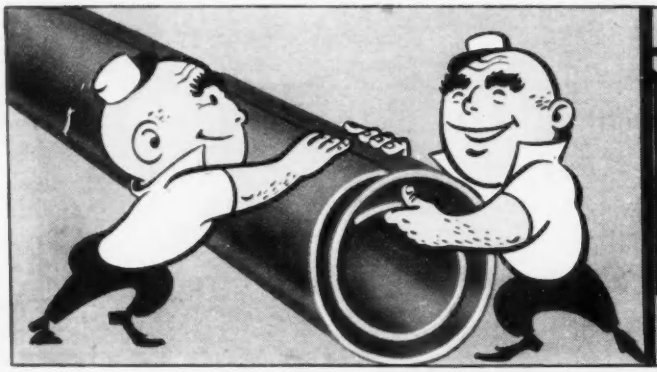
INSIDE STORY OF BUNDYWELD



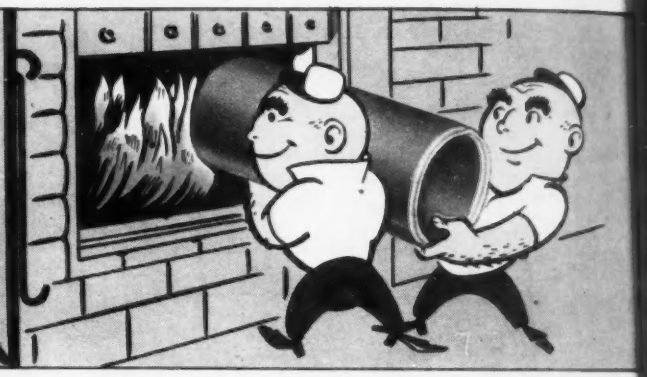
1 Bundyweld Steel Tubing is made by a process entirely different from that used in the making of any other tubing. A single strip . . .



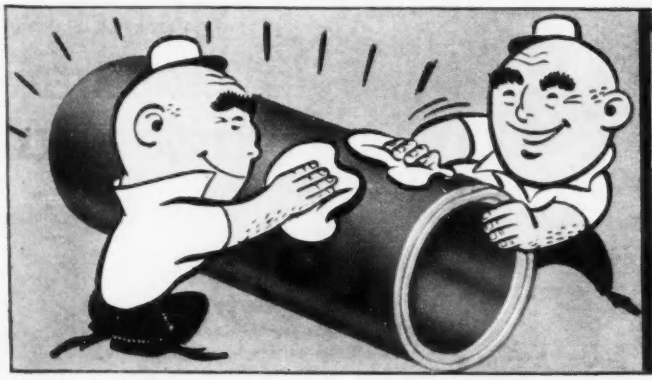
2 . . . of copper-coated S.A.E. 1010 steel is *continuously* rolled twice around *laterally* into tubular form. Walls of uniform thickness and concentricity . . .



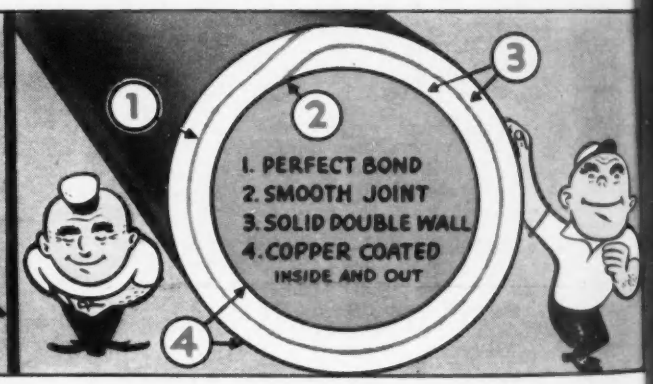
3 . . . are assured by the use of close tolerance cold rolled strip. This double rolled strip in tubular form is next passed through . . .



4 . . . a brazing furnace, where the copper coating fuses and alloys with the double steel walls. After brazing and cooling, the tubing has become . . .



5 . . . A SOLID double wall steel tube completely copper brazed throughout 360° of wall contact, copper coated inside and out, free from scale and closely held to dimensions.



6 Bundyweld is furnished hard or annealed in a wide range of standard diameters and gauges up to 5/8" O.D. Special sizes, cold drawn as desired. Also furnished in Monel.

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Eagle Metals Co.
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bruary, 1946

News..

..OF THE SOCIETY

Technical Board Spurs Projects With Swift, Stimulating Actions

SWINGING into full-scale operation, the SAE Technical Board has gone far toward integrating various standards divisions and other technical committees into the new committee structure of the Board, has authorized a study group to develop a specific plan for continuous peacetime cooperation between the SAE and Army Ordnance, and has specifically approved new or continued activity on a variety of projects.

Specific action was taken at a Jan. 10 meeting on SAE participation in two standardization areas long of importance in SAE technical annals, namely, screw thread standardization and ball and roller bearings standardization.

During the war, under the Combined Production and Resources Board, considerable effort had been made to unify screw thread practices in countries which use the inch system of measurement. Last fall, representatives of the United States, Great Britain, and Canada met in Ottawa for an extended conference covering this subject and other related matters. (See *SAE Journal*, July, 1945, p. 19.)

Because of this and other developments, screw thread standardization presents important problems of continued significance to SAE members. Consequently, the Technical Board determined to review the entire situation carefully, and to implement such a review, named a committee consisting of Gustaf Carvelli, Wright Aeronautical Corp., W. L. Barth, General Motors Corp., and H. A. Marchant, Chrysler Corp. This committee will make recommendations to the Board.

Action on ball and roller bearings standardization, intended to stimulate progress in both the national and international fields, was based on a study of more than a year which had been made by the Ball and Roller Bearings Division of the SAE Standards Committee. Based on this work, the Board has recommended to the American Standards Association that the Anti-Friction Bearing Manufacturers Association be invited to become a cosponsor of the ASA Sectional Committee on Ball and Roller Bearings Standards, present sponsors of which are the SAE and the Society of Mechanical Engineers; and that responsibility for the secretariat of this committee be transferred from the SAE to the Anti-Friction Bearing Manufacturers Association.

Numerous other technical projects were acted upon by the Technical Board at this January session.

Bumper Heights Revival

Revival of a prewar project to investigate the possibilities of standardization of bumper heights was among the important projects approved. Board Member J. H. Hunt is acting as sponsor and a committee including representatives from all passenger car and from many truck companies already is in action. Three subcommittees have been set up – one on passenger car bumper heights, one on truck bumper heights, and one to recommend strength and resistance of bumpers. The subcommittees are preparing up-to-date tabulations of current practice, similar to tabulations prepared back in 1939-1940 when SAE first started work at the request of the Automobile Manufacturers Association. The earlier work, including studies made in 1940 by SAE Transportation and Maintenance groups, is being used as a basis of the current studies.

Porous Chrome Plating

A project on porous chrome plating, originally undertaken for the U. S. Navy by a War Engineering Board subcommittee, is being continued at the request of the Navy which urges that, since the war is over, it is more important than ever to find out how to lengthen the life of Navy diesels because of the postwar cut-down in spare parts and service equipment. (The War Engineering Board has been officially disbanded and this porous chrome plating project, along with all other uncompleted W.E.B. projects, now functions directly under the SAE Technical Board.)

Bronze Castings

Similarly, an active committee working on process control of bronze castings (previously under W.E.B. auspices) is being continued actively under Technical Board authorization. It will function as a project of the Non-Ferrous Materials Committee.

More Spring Manuals

A Spring Committee (which achieved outstanding results under W.E.B. sponsorship during the war) is going forward under the peacetime Technical Board organization to prepare manuals covering torsion bar, Bellville and ring springs. These will be valuable additions to the manuals on helical and spiral springs, leaf springs and volute springs previously produced by this committee. Board Member J. C. Zeder is sponsor for the project.

T & M Group Active

An attempt to develop standard nomenclature for different types of trucks and combinations is an important new project authorized by the Board under the sponsorship of Board Member Gavin W. Laurie. Mr. Laurie will undertake organization of an appropriate committee to undertake the work in consultation with the chairman of the Motor Coach & Motor Truck Committee and the chairman of the T&M Technical Committee. A number of other T&M projects were approved as well.

Committees Reoriented

Progress toward reorientation of SAE standardization divisions into the new technical committee structure – which will expand the permissible scope of these groups to encompass research and other technical work as necessary – has been made by the Board. Definitely reconstituted as committees of the Technical Board were the erstwhile standards committee divisions on ball and roller bearings, electrical equipment, iron and steel, lighting, lubricants, motor coach and motor truck, non-ferrous metals, parts and fittings, passenger car bodies, and screw threads. Further study is being made of the remaining groups with action likely at an early date.

Board action included also:

(1) Appointment of Gavin W. Laurie, Atlantic Refining Co., as SAE representative to the Technical Advisory Board of the Army Transportation Corps.

(2) Appointment as SAE representatives to the ASA Sectional Committee on Safety Code for Specifications and Methods of Test for Safety Glass of R. E. VanDeventer of Packard, C. E. Heussner of Chrysler, J. L. McCloud of Ford and H. C. Mougey of General Motors;

(3) Appointment of C. G. A. Rosen, Caterpillar Tractor Co., as SAE representative on the Heat Transfer Division Coordination Committee of the American Society of Mechanical Engineers;

(4) Appointment of W. P. Eddy, Pratt & Whitney, as chairman of the SAE Iron and Steel Committee, following the resignation because of ill health of Frank P. Gilligan, Souther Engineering Co.

The Board also approved finally a set of rules and regulations for its own operation, copies of which are available to members upon request.

Crawford Succeeds Bachman as CRC Head

SAE Past-President James M. Crawford, General Motors Corp., has been elected president of the Coordinating Research Council, Inc., for 1946, succeeding SAE Past-President B. B. Bachman, Autocar Co., who retires after having held the post since inception of the Council. C. E. Davis, Shell Oil Co., was elected to succeed T. G. Delbridge, Atlantic Refining Co., as vice-president. Mr. Bachman and Mr. Delbridge continue as members of the Board of the Coordinating Research Council and all other directors were re-elected as follows: SAE representatives: W. S. James, Ford Motor Co.; William Littlewood, American Airlines; Arthur Nutt, Packard Motor Car Co.; C. G. A. Rosen, Caterpillar Tractor Co.; J. C. Zeder, Chrysler Corp., and Mr. Bachman and Mr. Crawford. American Petroleum Institute representatives: D. P. Barnard, Standard Oil Co. (Ind.); G. H. B. Davis, Standard Oil Development Co.; R. A. Halloran, California Research Corp.; K. G. Mackenzie, The Texas Co.; G. G. Oberfell, Phillips Petroleum Co., and Messrs. Delbridge and Davis.

Body Standards Work on the March

COMPLETION of organization of a subdivision on barrel locks and keys under the chairmanship of E. L. Allen, Schonitzer Engineering Co., was reported at the Jan. 21 meeting of the Passenger Car Body Division of the SAE Standards Committee, as was progress toward organization of seven other subcommittees.

Division Chairman E. C. DeSmet reported that demands on engineers' time in the reconversion period following V-J Day had prevented rapid progress on many Division projects, but that more action was to be expected from now on. Among the subdivisions on which preliminary organization work has begun are those on window and door glass, window channels, window regulator handles, inside door handles, body and sheet metal nomenclature, fiber and cardboard, and molding and clips.

Standard Test Suggested

A suggestion from L. M. Ball of Chrysler Corp. for establishment of a standard test for automotive acoustic materials was tabled for further consideration pending a check with the American Society for Testing Materials as to whether or not any ASTM standard methods are available or being formulated.

Rambling Throug

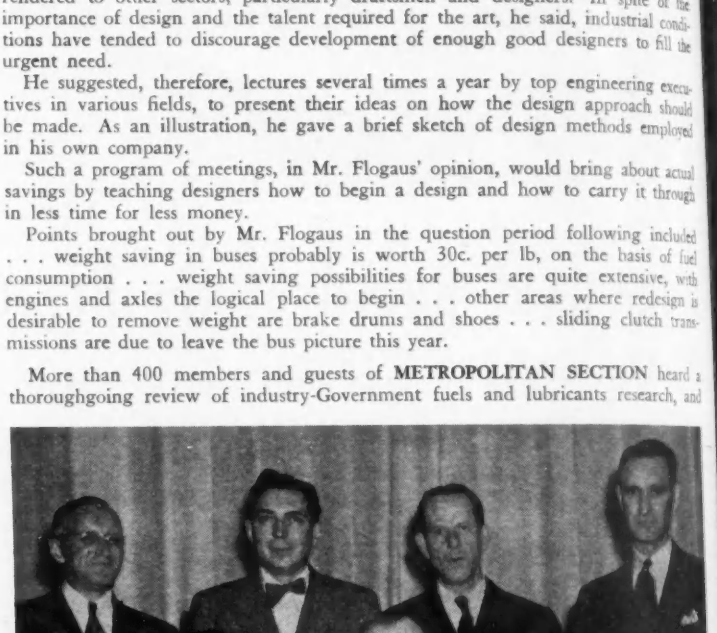
PROPOSING an educational type of meeting as a regular activity of SAE, Howard Flogaus, vice-president of engineering, J. G. Brill Co., launched a new idea at **DETROIT SECTION** meeting, Jan. 21, in his discussion of "Fundamentals of Bus Design." In his opinion, SAE papers have leaned toward the interests of less than half the members, ignoring educational services that might and should be rendered to other sectors, particularly draftsmen and designers. In spite of the importance of design and the talent required for the art, he said, industrial conditions have tended to discourage development of enough good designers to fill the urgent need.

He suggested, therefore, lectures several times a year by top engineering executives in various fields, to present their ideas on how the design approach should be made. As an illustration, he gave a brief sketch of design methods employed in his own company.

Such a program of meetings, in Mr. Flogaus' opinion, would bring about actual savings by teaching designers how to begin a design and how to carry it through in less time for less money.

Points brought out by Mr. Flogaus in the question period following included . . . weight saving in buses probably is worth 30c. per lb, on the basis of fuel consumption . . . weight saving possibilities for buses are quite extensive, with engines and axles the logical place to begin . . . other areas where redesign is desirable to remove weight are brake drums and shoes . . . sliding clutch transmissions are due to leave the bus picture this year.

More than 400 members and guests of **METROPOLITAN SECTION** heard a thoroughgoing review of industry-Government fuels and lubricants research, and



Seated (left to right): Walter C. Ainsley, director, Grease Projects; Lt.-Col. R. E. Jeffrey, Jr., project officer on War Advisory Committee; C. B. Veal, Manager, Coordinating Research Council, Inc. Standing (left to right): Leonard Raymond, Metropolitan Section vice-chairman; P. V. Keyser, director, Gear Oil Projects; Prof. H. W. Best, leader, Full-Scale Detonation Program and Analysis Group, and J. R. Sabina, director, Gasoline Additives Projects

an interpretation of the value of this work to the automotive industry and equipment users in the postwar era. The speakers were five project leaders and included W. G. Ainsley, Sinclair Refining Co., on Greases; P. V. Keyser, Socony-Vacuum Oil Co., Inc., on Gear Lubricants; J. R. Sabina, E. I. duPont de Nemours & Co., Inc., on Gasoline; Lt.-Col. R. E. Jeffrey, Jr., Office of the Chief of Ordnance on Heavy-Duty Oils; and Prof. H. W. Best, Yale University, on Significance of Octane Number. C. B. Veal, manager, Coordinating Research Council, Inc., who with Vice-Chairman Leonard Raymond, Socony-Vacuum Oil Co., arranged the meeting, introduced the speakers.

Reason for not much change in diesel engine design during the past decade is the paucity of combustion chamber research, it was disclosed at the Diesel Engineering Meeting of Metropolitan Section, Feb. 7. The speaker, R. K. Weldy, Ex-Cell-O Corp., reviewed the historical background of diesel engines, and described in detail the fuel injection equipment of his company. The speaker talked with the aid of slides, and his presentation was followed by a lively discussion. Chairman was Richard Creter, the Section's vice-chairman for Diesel Engineering. More than 300 attended the meeting.

Col. Joseph D. Arthur, assistant engineer, Commissioner of the District of Columbia, spoke to **WASHINGTON SECTION**, Jan. 10, on "Postwar Highway Construction in Washington, D. C.," outlining the detailed projects afoot for the improvement of present traffic and parking conditions.

Speakers at **CLEVELAND SECTION** T&M meeting, Jan. 14, were H. L. Hemmingway, Pure Oil Co., who spoke on "Developments in Chassis Lubrication"

Section Reports

and John Zimmer, Socony-Vacuum Oil Co., Inc. Noteworthy addition to the meeting was the presence of about 15 fleet operators from the Cleveland area, invited by T&M Activity Chairman William S. Piwonka.

Jan. 21 meeting of **HAWAIIAN SECTION** featured a paper on "The Future of Trucking in Hawaii," by LeRoy D. Bush, Honolulu Construction & Draying Co. and Hawaiian Trucking Association. As a further attraction, two sound pictures were shown—"Oil for Tomorrow," a portrayal of oil development from discovery to refinery, and "Tornado in a Box," the story of the gas turbine.

"Diesel Developments and Applications in Germany" were described by C. J. Vogt, University of Calif., at **NORTHERN CALIFORNIA SECTION** meeting, Jan. 8. Recently returned from a five months' inspection tour of diesel engine manufacturing facilities in Europe as a lieutenant-commander and a member of the Naval Technical Mission Europe, and now on terminal leave, Prof. Vogt reported that facts gathered from relatively intact plants in southwestern Germany showed that diesel engines of quite advanced design were in production. Details of German practice brought out by this survey included: use of V-type cylinder arrangement for marine application . . . omission of torsional vibration dampers on crankshafts . . . little use of opposed piston engines, some double acting and some 2-cycle engines . . . preference for welded frame construction, with cast construction employed throughout only on low performance models . . . no use of special detergent oils or high cetane fuels, since they were not available . . . adaptation of engines to existing fuels by means of modifications of the injection system.

In spite of the crippling effects of the war, Prof. Vogt said, the competition of the German diesel industry has not been eliminated; there is a good backlog of ideas, and considerable technical skill still exists. Therefore, he believes the German diesel industry may have great significance in the future development of diesel engines.

Newly formed **WILLIAMSPORT GROUP** was successfully launched Jan. 7, with 34 members present at this first regular meeting. Following the election of J. C. McRoberts, Clay Ballinger, W. S. Faust and W. C. Jamouneau as nominating committee, four motion pictures were shown: "The Cathode Ray Oscilloscope," "The Story of the Helicopter," "How to Fly the P-47," and "Building the Alcan Highway."

Addressing **CANADIAN SECTION,** Jan. 16, Mr. Stout comprehensively surveyed future automotive developments, in a talk ranging from the potentialities

Ten Canadian Section past-chairmen, members of its governing board, and two special guests were among those present at luncheon held in honor of William B. Stout at the Granite Club, Toronto, preceding the Section's dinner meeting, Dec. 19. Chairman George J. Beattie, host of the luncheon, is at head of table. Beyond him is Mr. Stout. Near side of table (l. to r.): W. W. Taylor, chairman, Entertainment Committee; Clifford E. Phillips, chairman, Membership Committee; Alex Gray, Section past-chairman; Adam F. Smith, chairman, Publicity Committee; R. Nelles Starr; R. W. Richards, past-chairman; J. P. Bickell, chairman, Program Committee; Col. Max Evans, past-chairman; Col. Alex McArthur, past-chairman; N. H. Daniel, past-chairman; and C. E. McTavish, section vice-chairman. Far side of table (l. to r.): Warren B. Hastings, Section secretary; A. Frank Oliver, chairman, Meetings Committee; J. C. Armer, SAE Councilor and Section past-chairman; Fred J. Beattie, Hamilton regional vice-chairman; Marcus L. Brown, past-chairman; F. M. Buckingham, Section treasurer; C. E. Tilston, past-councilor and past-chairman; W. E. McGraw, past-councilor and past-chairman; Howard B. Moore, Federation of Automobile Dealer Associations of Canada, and George M. Garner, past-chairman

Continued on next page

CRC Names McLeod Assistant Manager

APPOINTMENT of Major Milton K. McLeod as assistant manager of the Coordinating Research Council, Inc., was announced today by the Council. C. B. Veal continues as manager of CRC.

The new office was created recently by the Board of Directors of the Council and Major McLeod is beginning his new duties immediately.

Major McLeod, for several years prior to joining the Army, was active as a member

Milton K. McLeod

of various groups of the Coordinating Research Council and, as an Officer of the Army Air Forces, represented the Air Technical Service Command on a number of the Council's research projects in which the Army Air Forces had a direct interest.

Major McLeod was graduated by the Massachusetts Institute of Technology in 1935 with the degree of Bachelor of Science, and in 1937 received his Master of Science degree from that institution. From June, 1935, to September, 1937, he was instructor in the Automotive Engine Laboratory at the Massachusetts Institute of Technology. This work involved instruction of undergraduate classes in basic automotive engine theory, supervision of laboratory experiments and the direction of thesis work of graduate students.

From September, 1937, to July, 1942, he was employed as research engineer by the Waukesha Motor Co. of Waukesha, Wis. His work with the Waukesha Motor Co. involved research in connection with engine-fuel and engine-lubricant characteristics and relationships of diesel, natural gas and gasoline engines for automotive and industrial applications.

From September, 1939, to June, 1941, Major McLeod served as instructor in a diesel engine course at Beloit College Evening School.

He was commissioned in the Coast Artillery Guard Reserve in June, 1935, and joined the Army Air Forces at Wright Field in July, 1942, where he was assigned to the Power Plant Laboratory.

In August, 1943, he was assigned to the coordination of the fuel development programs of the U. S. Army Air Forces with the aircraft and aircraft engine manufacturers, and the supervision of an extensive test program which determined the fuel requirements of service aircraft.

Major McLeod was released by the Army and reverted to inactive status on Dec. 8, 1945.

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of atomic energy to a description of possible telescopic trailer bodies, heated by 100 octane gas, for use as huts and workshops in Alaska and the Aleutians.

A record 400 attended **SOUTHERN CALIFORNIA SECTION** meeting, Jan. 11, to hear Maurice J. Zucrow, Aerojet Engineering Corp., discuss "The Rocket Powerplant." Dr. Zucrow covered both theoretical and practical aspects of the problem, and included detail derivations of basic equations dealing with rocket power. Prodigious German fighter performance was afterwards illustrated in a movie of the ME-163. Recently liberated by Ward Beman, Lockheed Aircraft Corp., the film showed this plane to be far advanced in the rocket propulsion field. It was able to operate at tremendous speeds with full control, and, in Mr. Beman's opinion, defense against it would have been next to impossible. He expressed the hope that the American aircraft industry will profit by information obtained from German sources, and will continue experimental work on this type of aircraft.

SAE Past-President William B. Stout, Consolidated Vultee Aircraft Corp. and Graham-Paige Motors Corp., was speaker for the Dec. 5 meeting of **DAYTON SECTION.** Discussing "Imagineering for the Postwar World," Mr. Stout pointed out that development of proper methods of testing and recording results has taken us out of the days when products were built rather than developed, and engineers stopped experimenting as soon as they had a product that worked. Increased development costs, he said, require a greatly expanded market. Answer to this problem, and an antidote to industrial conflict, he believes, is for industry to cease forgetting that labor is the consumer, and for consumers to remember that industry is the supplier of needs.

Wallace Linville, General Petroleum Corp. of Calif., entertained and instructed 300 engineers at **SOUTHERN CALIFORNIA SECTION** meeting, Dec. 7, with a uniquely illustrated talk on "Present Day Automobiles and their Efficient Performance." Mr. Linville made use of a large number of props and gadgets to illustrate his technical discussion of the molecular and atomic structure of the naphthenic and paraffinic oils. In this way he demonstrated removal of sludge from an engine by removing an oil spot from a piece of cloth with detergent, and showed detonation in a glass tube.

Following the showing of war films illustrating wartime engine requirements, R. E. Whitacre, Wright Aeronautical Corp., addressed **CINCINNATI SECTION,** Sept. 13, on construction and engineering features of the Wright Cyclone R-3350 Engine. Complete engine and numerous parts were displayed to supplement his report.

DAYTON SECTION on Jan. 16 heard Major P. M. Thomas and Capt. G. H. Coles describe the work of the Special Photographic Service Section at Wright Field, of which both are members. Major Thomas, who set up the Special Section to assist all branches of engineering at Wright Field, said that their job is to do photography work for the engineers so that more detailed studies of flutter, vibrations, shock, and so on could be made. Equipment, he said, is mainly of two types: conventional camera with a high speed shutter, and constant light camera with no shutter. On the latter, the light is controlled, and sharp frame lines are established in a rotating prism.

Capt. Coles, an electrical engineer largely responsible for developing the special equipment and procedures employed, showed films taken in connection with various tests, and explained technical difficulties encountered and means necessary to obtain photographic records. Tests included landing gear drop tests, parachute tests, helicopter take-offs, buzz-bomb take-offs and so on.

SAE JOURNAL FIELD EDITORS

Baltimore – Webster H. Francis, Jr.
Buffalo – No Appointment
Canadian – Warren B. Hastings
Chicago – Austin W. Stromberg
Cincinnati – Charles W. Coote
Cleveland – Richard E. Brown
Dayton – W. D. Hazlett
Detroit – W. F. Sherman
Hawaiian – Al Molloy
Indiana – Harlow Hyde
Kansas City – Harold F. Twyman
Metropolitan – Duis W. Meador
Mid-Continent – No Appointment
Milwaukee – L. A. Wilson
New England – Arnold R. Okuro
No. California – J. H. MacPherson
Northwest – Paul P. Olson
Oregon – No Appointment
Peoria – No Appointment
Philadelphia – Laurence Cooper
Pittsburgh – Murray Fahnestock
St. Louis – C. C. Butterworth
So. California – T. D. MacGregor
San Diego Division – Grant B. Hodgson
So. New England – Claude O. Broders
Syracuse – No Appointment
Texas – Thomas Ashley
Washington – E. K. Owens
Western Michigan – E. M. Jacoby
Wichita – No Appointment
Colorado Group – No Appointment
Mohawk-Hudson Group – No Appointment
Salt Lake Group – David Brown
Spokane Group – No Appointment
Twin City Group – George S. Johnson
Virginia Group – No Appointment
Williamsport – No Appointment

TIIC Automotive Team To Report at SAE Meeting

HIGHLIGHTS of 61 technical reports prepared by the 13 members of the Automotive Subcommittee of the TIIC (Technical Industrial Intelligence Committee) to summarize the findings of their recent German mission, will be presented at the SAE Summer Meeting, French Lick Springs Hotel, French Lick, Ind., June 2-7, 1946.

Special Symposium and Exhibit

A special evening symposium and an exhibit of equipment brought back from Germany are being arranged by an Automotive Industry Advisory Committee working in cooperation with the SAE Meetings Committee. Composed predominantly of SAE members, this Advisory Committee was organized to direct the dissemination of the automotive group's findings among engineers and executives of the industry. Personnel is as follows: Dr. H. C. Dickinson, Department of Commerce, Chairman; B. B. Bachman, Autocar Co.; Arch T. Colwell, Thompson Products, Inc.; John A. Detlefsen, Technical Industrial Intelligence Branch, secretary; A. W. Herrington, Marmon-Herrington Co., Inc.; W. S. James, Ford Motor Co.; O. D. Treiber, Hercules Motors Corp.; and Austin M. Wolf, consultant.

Team Members

SAE members also are in the majority of the Automotive Team that went to Germany. The 13 members are as follows:

O. D. Treiber, European Representative and Leader, Hercules Motors Corp.
L. E. Bogue, Bendix Products Division.
Stephen DuPont, Indian Motorcycle Co.
Norman Hoertz, Thompson Products, Inc.
R. C. Mathewson, American Bosch Co.
A. M. Madle, Briggs and Stratton Corp.
A. B. Modine, Modine Mfg. Co.
E. F. Norelius, Allis-Chalmers Mfg. Co.
A. J. Poole, Bendix Aviation Corp.
A. W. Pope, Jr., Waukesha Motor Co.
F. H. Ragan, Detroit Aluminum Brass Co.
W. F. Shurtz, Twin Disc Clutch Co.
A. M. Wolf, consulting engineer and Director of Standards, State of New York.

Copies of declassified technical reports prepared by members of the Automotive Subcommittee will soon be made available by the Department of Commerce, Office of the Publication Board, Washington 25, D. C.

Belgian Greetings

VISITING in the United States in December and January, Prof. Albert J. Jadot of Belgian University took occasion to bring greetings to the SAE on behalf of Belgian automotive engineers in general and on behalf of the Belgian University. Accompanying Prof. Jadot was R. Malengret-Lebrun.

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Journal Index Available

A complete Index covering the twelve 1945 issues (Vol. 53) of the *SAE Journal* is now available to members and subscribers free upon request.

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